Gateway Energy Centre

UNDERGROUND GAS PIPELINE AND ASSOCIATED ABOVE GROUND INSTALLATION

ENVIRONMENTAL STATEMENT FURTHER INFORMATION DOCUMENT

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125 YEARS

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CONTENTS

LIST OF ABBREVIATIONS

3LPE	3 layer polyethylene
AC	Alternating Current
ACC	Air Cooled Condenser
AGI	Above Ground Installation
AOD	Above Ordnance Datum
AUT	Automatic Ultrasonic Testing
BAP	Biodiversity Action Plan
BP	British Petroleum
BPA	British Pipelines Agency
BS	British standard
BT	British Telecom
CAA	Civil Aviation Authority
CCGT	Combined Cycle Gas Turbine
CCR	Carbon Capture Readiness
CCTV	Closed Circuit Television
CD	Compact Disc
CDM	Construction Design and Management
CECL	Coryton Energy Company Limited
CEMP	Construction Environmental Management Plan
CHP	Combined Heat and Power
CIPS	Close Internal Potential Survey
CLG	Department for Communities and Local Government
CLR	Corringham Light Railway
CO2	Carbon Dioxide
CP	Cathodic Protection
CPBC	Castle Point Borough Council
CTMP	Construction Transport Management Plan
DC	Direct Current
DCO	Development consent Order
DCVG	Direct Current Voltage Gradient
DECC	Department of Energy and Climate Change
DX	Ditch Crossing
ECC	Essex County Council
EEDA	East of England Development Agency
EIA	Environmental Impact Assessment
EN	European Norm
ES	Environmental Statement
ESD	Emergency Shutdown Device
ES FID	Environmental Statement Further Information Document
EU	European Union
FBE	Fusion Bonded Epoxy
GEC	Gateway Energy Centre
GECL	Gateway Energy Centre Limited
GRF	Gas Reception Facility
GRP	Gas Reinforced Plastic
GW	Gigawatt
ha	hectares

HDD	Horizontal Directional Drill
HEO	Harbour Empowerment Order
HGV	Heavy Goods Vehicle
HRSG	Heat Recovery Steam Generator
HSC	Hazardous Substances Consent
HSE	Health and Safety Executive
HV	High Voltage
IEMA	Institute of Environmental Management and Assessment
IGE	Institute of Gas Engineers
IPC	Infrastructure Planning Commission
km	kilometers
kV	Kilovolts
LCPD	Large Combustion Plant Directive
LCV	Lower Calorific Value
LG	London Gateway
LPA	Local Planning Authority
LX	Lake Crossing
m	metres
mm	millimetres
MAPD	Major Accident Prevention Document
MAOP	Maximum Allowable Pressure
MOC	Minimum Offtake Connection
MOD	Ministry of Defence
MOF	Minimum Offtake Facility
MWe	Megawatts Electrical
N2	Nitrogen
NG	National Grid
NOx	Nitrogen Oxides
NPS	National Policy Statement
NPS EN-1	Revised Draft Overarching National Policy Statement for Energy (EN-1)
NSIPs	National Significant Infrastructure Projects
NTaS	National Transmission System
NTS	Non-Technical Summary
OFGEM	Office of the Gas and Electricity Markets
OLIV	On-line Inspection Vehicles
OPA	Outline Planning Application
OPA	Oil Pipelines Agency
OS	Ordnance Survey
PB	Parsons Brinckerhoff
PIG	Pipeline Internal Gauge
PLX	Pipeline Crossing
PP	Planning Permission
PPS	Planning Policy Statement
PSR	Pipelines Safety Regulations
PSSR	Pressure System Safety Regulations
RDX	Road Crossing
RLX	Rail Crossing
RTU	Remote Terminal Unit
RVX	River Crossing

SINC	Site of Importance for Nature Conservation
SO2	Sulphur dioxide
SPEAC	Shellhaven Project Environmental Action Committee
TBC	Thurrock Borough Council
TEU	Twenty-foot Equivalent Shipping Container Units
TLX	Track Crossing
TR	Transformer Rectifier
TTGDC	Thurrock Thames Gateway Development Corporation
TWAO	Transport and Works Act Order
UK	United Kingdom
UPS	Uninterruptible Power Supply

PREFACE

In February 2010, Gateway Energy Centre Limited (GECL) submitted an application for consent under Section 36 of the Electricity Act 1989 to the Secretary of State for Energy and Climate Change to construct a 900 Megawatts Electrical (MWe) Combined Cycle Gas Turbine (CCGT) Power Plant to be known as Gateway Energy Centre (GEC). In addition, a direction that planning permission be deemed to be granted under Section 90 of the Town and Country Planning Act 1990 was also sought. The application was accompanied by an Environmental Statement (ES) prepared in accordance with the requirements of the Electricity Works (Environmental Impact Assessment) (England and Wales) Regulations 2000 (as amended).

Following submission of the Section 36 consent application, consultation responses were received and meetings were held with key consultees from which clarifications on the application were sought and supplementary information requested. The clarifications and supplementary information were presented in an Environmental Statement Further Information Document (ES FID), accompanied by a number of supporting documents and submitted to the Department of Energy and Climate Change (DECC) in December 2010.

The proposed GEC is to be located on land within the London Gateway Port / London Gateway Logistics and Business Park development, collectively called the LG Development, which is being promoted by DP World and is currently in the early stages of construction.

Further to the development of GEC, GECL proposes to construct an underground gas pipeline and associated above ground installation (AGI) required in connection with the development of GEC. In March 2011, GECL submitted an application for planning permission to Thurrock Thames Gateway Development Corporation (TTGDC) under the Town and Country Planning Act 1990 for the installation of the proposed underground gas pipeline and associated AGI. The application was accompanied by an ES prepared in accordance with the requirements of the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999, as amended.

The installation of electrical infrastructure for the High Voltage (HV) grid connection associated with the development of GEC will be the subject of a separate application to be made in due course to either TTGDC or Thurrock Council under the Town and Country Planning Act 1990 and / or under the Planning Act 2008 to the Infrastructure Planning Commission (IPC), or to the Major Infrastructure Planning Unit (MIPU) which will replace the IPC.

Following submission of the application for the underground gas pipeline and associated AGI, consultation responses were received and meetings were held with certain of those parties. In addition, since submission of the application in March 2011 certain changes in planning and energy policy have occurred. The ES FID and the accompanying appendices, which have been provided to TTGDC, provides further information in these regards.

The following terms are adopted for the purposes of this ES FID:

- *"Further Information"* means additional information provided by the applicant to supplement the information in the ES.
- *"Any Other Information"* means any other substantive information relating to the ES and provided by the applicant.
- *"Supplementary Information"* means the further information and any other information.

The ES FID is provided to supplement the information provided in the ES, and will be advertised by TTGDC as if it had been requested pursuant to Regulation 19 of the Town and Country Planning (Environmental Impact Assessment) (England and Wales) Regulations 1999 ("the 1999 EIA Regulations").

Notice of the March 2011 application for planning permission for the underground gas pipeline and associated AGI, was advertised under Article 13(3) of the Town and Country Planning (Development Management Procedure) (England) Order 2010.

Should members of the general public wish to make a representation regarding the application for planning permission for the underground gas pipeline and associated AGI, then these should be addressed to:

Matthew Gallagher
Planning Development Office
Thurrock Thames Gateway Development Corporation
2nd Floor, Civic Offices (CO1)
New Road
Grays
Essex
RM17 6SL

Copies of the March 2011 application for planning permission (with a plan showing the land to which it relates), the ES explaining GECL's proposals in more detail and presenting an analysis of the environmental effects of the underground gas pipeline and associated AGI, the non-technical summary (NTS) of the ES and planning statement) and the July 2011 ES FID and supplementary planning statement may be inspected during normal office hours at the following addresses:

Thurrock Thames Gateway Development Corporation
2nd Floor, Civic Offices (CO1)
New Road
Grays
Essex
RM17 6SL

Thurrock Council
Civic Offices
New Road
Grays
Essex
RM17 6SL

Opening hours:	Monday to Thursday:	8:45 am to 5:15 pm
	Friday:	8:45 am to 4:45 pm

Stanford-Le-Hope Library
High Street
Stanford-le-Hope
Essex
SS17 0HG

Opening hours:	Monday:	10 am to 1pm / 2 pm to 6 pm
	Tuesday:	10 am to 1pm / 2 pm to 5 pm
	Wednesday:	Closed
	Thursday:	10 am to 1pm / 2 pm to 6 pm
	Friday:	10 am to 1pm / 2 pm to 5 pm
	Saturday:	10 am to 1pm / 2 pm to 5 pm

Corringham Library
Communities, Libraries and Cultural Services
St John's Way
Corringham
Essex
RM17 7LJ

Opening hours:	Monday:	9 am to 7 pm
	Tuesday:	9 am to 5 pm
	Wednesday:	9 am to 1 pm
	Thursday:	9 am to 7 pm
	Friday:	9 am to 5 pm
	Saturday:	9 am to 5 pm

An electronic version of the application for planning permission and associated documents, including the ES and the ES FID can be downloaded, free of charge, at the GEC website:

http://www.gatewayenergycentre.co.uk

Paper copies of the ES and ES FID (including the stand-alone documents) can be purchased for a fee of £250; or a copy of the ES FID for a fee of £50 for each copy by writing to:

Chris Brake
Dalton Warner Davis LLP
21 Garlick Hill, 3rd Floor
London
EC4V 2AU

CD copies of the ES and ES FID (including the stand-alone documents) can be purchased for a fee of £5 each.

Copies of the Non-Technical Summary are available free of charge.

1 INTRODUCTION

1.1 Background to the ES FID

1.1.1 Since submission of the application for planning permission for the underground gas pipeline and associated AGI, accompanied by the March 2011 ES, changes have been made to planning and energy policy. These changes, which affect the March 2011 ES, are identified in this ES FID. The relevant parts of the March 2011 ES Section 2 and Section 3 have been revised to reflect those changes.

1.1.2 Also, since submission of the application for planning permission, representations have been made by third parties to TTGDC. The representations made by Oikos Storage Ltd (Agent: Adams Hendry), Shell UK Ltd (Shell) (Agent: Jones Lang LaSalle), Essex County Council (ECC) (Historic Environment Branch) and Thurrock Council are contained in Appendix A.1.

1.1.3 In order to clarify issues raised in those representations contained in Appendix A.1, Further Information has been provided in respect of:

- Gas Pipeline Route and AGI Location Selection;
- Construction Methods and Operation;
- Land Use;
- Landscape and Visual;
- Land Use / Geology, Hydrology and Hydrogeology;
- Cultural Heritage; and
- Indirect / Secondary and Cumulative Impacts.

1.2 Relationship between the ES and ES FID

1.2.1 Table 1.1 identifies the Further Information provided in this ES FID, and its relationship with the information provided in the March 2011 ES. References to N / A (not applicable), signifies that there is no change to that section of the March 2011 ES.

TABLE 1.1 – RELATIONSHIP BETWEEN THE ES AND ES FID

ES Section	***Further Information***	***Notes***
Section 1 – Introduction	N / A	N / A
Section 2 – Rationale for Development	Since submission of the March 2011 ES, Parliament has approved National Policy Statements (NPSs) for Energy (July 2011). The information provided in the March 2011 ES (Section 2) has been updated to reflect those changes.	Further Information is provided in this ES FID in ***Section 2 – Planning and Energy Policy.*** Supporting information is provided in ***Appendix B.1 – Updated March 2011 ES Section 2.4***
Section 3 – Planning Policy Context	Since submission of the March 2011 ES, new advice on Planning for Growth has been released by HM Treasury and Department for Business Innovation and Skills (BIS), the Minister for Decentralisation, and the Department for Communities and Local Government. In addition, Parliament has approved NPSs for Energy. The information provided in the March 2011 ES (Section 3) has been updated to reflect these changes.	Further Information is provided in this ES FID in ***Section 2 – Planning and Energy Policy.*** Supporting information is provided in ***Appendix B.2 – Updated March 2011 ES Sections 3.2 and 3.3***
Section 4 – The GEC Development / GEC Site Surroundings	N / A	N / A
Section 5 – Gas Pipeline Route and AGI Location Selection and Description	The representation by Thurrock Council requested that the ES include further information on: • AGI Landscape Scheme and Design Details; • Pipeline Route Selection; • Pipeline and Ancillary Features Effects; and, • Cumulative Impacts.	Further Information is provided in this ES FID in ***Section 3 Gas Pipeline Route and AGI Location Selection***. .

ES Section	***Further Information***	***Notes***
Section 6 – Construction Methods and Operation	The representation on behalf of Oikos Storage Ltd (Agent: Adams Hendry) contends that the methods to be employed in crossing existing pipelines has not been identified and assessed in the March 2011 ES and that, as such, the likely significant environmental impacts of crossing existing pipelines have not been addressed.	Further Information is provided in this ES FID in ***Section 4 –Construction Methods and Operation***. Supporting information is provided in ***Appendix C.1 – Updated March 2011 ES Section 6***, and, ***Appendix C.2 – Likely Significant Environmental Impacts of Typical Crossing Techniques***
Section 7 – EIA Methodology and ES Content	N / A	N / A
Section 8 – Stakeholder Consultation and Additional Studies	The representation on behalf of Shell (Agent: Jones Lang LaSalle) has indicated concerns about the GECL application for planning permission concerning: • The health and safety impact of the dense phase CO_2 pipeline on the Shell land holding; • The health and safety impact of the electricity cables on the Shell land holding; • The impact of rights of access associated with the wayleaves on Shell landholding, including the health and safety risk to Shell operations as a result of the proposed gas pipeline maintenance; and • The impact of the wayleaves on Shell's long term access rights to the new Shell jetty via the LG Development Gate 3 Access Road.	Further Information is provided in this ES FID in ***Section 5 – Land Use***
Section 9 – Air Quality	N / A	N / A
Section 10 – Noise and Vibration	N / A	N / A
Section 11 – Landscape and Visual	The representation by Thurrock Council requested that the ES include further information on: • AGI Landscape Scheme and Design Details; • Pipeline Route Selection; • Pipeline and Ancillary Features Effects; and, • Cumulative Impacts.	Further Information is provided in this ES FID in ***Section 6 – Landscape and Visual***
Section 12 – Ecology	N / A	N / A

ES Section	***Further Information***	***Notes***
Section 13 – Land Use / Geology, Hydrology and Hydrogeology	The representation by Thurrock Council requested that the ES include further information on: • AGI Landscape Scheme and Design Details; • Pipeline Route Selection; • Pipeline and Ancillary Features Effects; and, • Cumulative Impacts.	Further information is provided in this ES FID in ***Section 7 – Land Use / Geology, Hydrology and Hydrogeology***
Section 14 – Transport and Infrastructure	N / A	N / A
Section 15 – Cultural Heritage	The representation by ECC (Historic Environment Branch) requested that the ES consider the effects of the development of the underground gas pipeline and associated AGI on cultural heritage / archaeology in a more comprehensive manner.	Further Information is provided in this ES FID in ***Section 8 –Cultural Heritage.*** Supporting information is provided ***Appendix D.1 – Heritage Assessment***
Section 16 – Socio-Economics	N / A	N / A
Section 17 – Safety	N / A	N / A
Section 18 – Indirect / Secondary and Cumulative Impacts	Based on the Further Information, it has been necessary to update the March 2011 ES Section 18.	Further Information is provided in this ES FID in ***Section 9 – Indirect / Secondary and Cumulative Impacts*** Supporting information is provided in ***Appendix E.1 – Updated March 2011 ES Section 18***

2 PLANNING AND ENERGY POLICY

2.1 Overview

2.1.1 Since the preparation of the March 2011 ES, there have been some changes in Planning and Energy Policy. These are summarised below:

- HM Treasury and BIS on 23/03/2011 published 'The Plan for Growth' which sets out the Government's objective to achieve strong, sustainable and balanced growth that is more evenly shared across the country and between industries.
- The Minister for Decentralisation (The Rt Hon Greg Clark MP) issued a written ministerial statement on 23/03/2011(Planning for Growth) which sets out policy on the approach to be taken to the determination of applications for planning permission.
- The Chief Planner, Communities and Local Government on 31/03/2011 wrote to Chief Planning Officers in Local Planning Authorities (LPAs) in England on Planning for Growth, drawing attention to objectives that must inform decisions by which the planning system should do everything it can to help secure a swift return to economic growth.
- On 18/7/2011, Parliament approved six NPSs for Energy; on 19/11/2011 , the Secretary of State for Energy designated the NPSs under the Planning Act 2008 (PA 2008), including:
    - Overarching National Policy Statement for Energy (EN-1) replaces the earlier Revised Draft EN-1 at ES 2.4.1 to 2.4.7 (Alterations to the March 2011 ES shown in Appendix B1) and ES 3.3.36 to 3.3.48 (Alterations to the March 2011 ES are provided in Appendix B2)
    - National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2) replaces the earlier Revised Draft EN-2 at ES 3.3.49 (Alterations to the March 2011 ES are provided in Appendix B2)
    - National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) replaces the earlier Revised Draft EN-4 at ES 3.3.50 to 3.3.56 (Alterations to the March 2011 ES are provided in Appendix B2).
    - National Policy Statement for Electricity Networks Infrastructure (EN-5) adds an additional paragraph at 3.3.57 (Alterations to the March 2011 ES are provided in Appendix B2).

Regional Strategies

2.1.2 On 27/05/2011, the Court of Appeal gave judgment in the case of R (Cala Homes (South)) v. Secretary of State for Communities and Local Government [2011] EWCA Civ 639, in which it ruled that LPAs and inspectors can take the Coalition Government's intentions to abolish RSs into consideration in deciding planning applications and appeals. Pending abolition, RSs remain part of the statutory development plan; the weight afforded to a material consideration depends on the individual circumstances and it is for the decision maker to decide on the appropriate weight. This information is relevant to the March 2011 ES 3.2.7 to 3.2.12. Alterations to the March 2011 ES are provided in Appendix B2.

National Policy

Planning

2.1.3 The Chief Planner at the DCLG wrote to LPAs in England on 31/03/2011 drawing attention to important announcements made in the March 2011 Budget. The letter refers to The Growth Review containing ambitious proposals for further planning reform to ensure that planning supports the sustainable development that is needed as the country emerges from recession. Annex A to the letter *Written Ministerial Statement: Planning for Growth*, issued by the Minister for Decentralisation, is capable of being regarded as a material planning consideration. It states: "*The Government's top priority in reforming the planning system is to promote sustainable economic growth and jobs. Government's clear expectation is that the answer to development and growth should, wherever possible, be "yes", except where this would compromise the key sustainable development principles set out in national planning policy*".

2.1.4 The Plan for Growth, published by HM Treasury, refers to measures outlined in the plan to help create a new model of economic growth by achieving four overarching ambitions for the British economy:

1. *To create the most competitive tax system in the G20*
2. *To make the UK one of the best places in Europe to start, finance and grow a business*
3. *To encourage investments and exports as a route to a more balanced economy*
4. *To create a more educated workforce that is the most flexible in Europe.*

2.1.5 Ambition 3 (above) refers to the significant need for investment as including renewal of the UK's energy infrastructure and that the "*Government's Electricity Market Reform consultation estimated that new investment of £110 billion in electricity generation and transmission would be needed in this decade to deliver secure, low-carbon energy supplies – over double the rate of the last decade*." (Paragraph 1.47) Ambition 4 (above), among its measurable benchmarks, includes supporting more apprenticeships than any previous Government and an emphasis on increasing the participation of 16 to 24 year olds in employment or learning. These measures are being reflected in the GECL Section 36 Consent application which includes, by way of a legal agreement, provision for apprenticeships during the construction process and commitments to provide young people with work experience for the operational life of the power station.

2.1.6 Among the challenges, faced by British businesses when seeking to expand or grow, is "*planning*"; the view expressed in *The Plan for Growth* is that the current system is holding back UK growth and jobs (paragraphs 2.1 to 2.4). The Plan refers to the Written Ministerial Statement of 23/03/2011 as expecting that LPAs and other bodies involved in granting development consents should prioritise jobs and growth. The Government is committed to ensuring that the planning system does everything it can to support growth and it points to its statement as being "*capable of becoming a material consideration in local planning decisions with immediate effect and [that] local authorities should press ahead and put in place development plans that are pro-growth." (Paragraph 2.9) In referring to competition, it states that "For the economy to succeed in the future, people and businesses will require reliable infrastructure in sectors such as energy, water, communications and transport*" (Paragraph 2.117).

2.1.7 On 25/7/2011, the Department for Communities and Local Government published the draft National Planning Policy Framework for consultation (NPPF) sets out the Government's economic, environmental and social planning policies for England; these articulate the vision of sustainable development to be interpreted and applied

locally. It notes that National Significant Infrastructure Projects (NSIPs) are determined by the decision making framework set out in national policy statements which are part of the overall framework of planning policy. The policies in this Framework apply to the preparation of local and neighbourhood plans and to development management decisions.

Energy

2.1.8 On 18/07/2011, Parliament debated and approved six NPSs for Energy (including EN-1, EN-2, EN-4, EN-5); on 19/7/2011, the Secretary of State for Energy designated the NPSs under the PA 2008. The Government Response to Parliamentary Scrutiny of the Revised Draft National Policy Statements for Energy Infrastructure (June 2011) states that "*The energy NPSs will be a blueprint for decision-making on individual applications for development consent for the relevant types of infrastructure*".

2.1.9 There is a link below to the relevant documents:

http://www.decc.gov.uk/en/content/cms/meeting_energy/consents_planning/nps_en_infra/nps_en_infra.aspx

2.1.10 The changes to the draft NPSs are, where relevant, referred to in the updated version of ES Section 2.4 (Appendix B1) and ES Sections 3.2 and 3.3 (Appendix B2).

3 GAS PIPELINE ROUTE AND AGI LOCATION SELECTION

3.1 Response to Thurrock Council

Pipeline Route Selection

Thurrock Council Representation

3.1.1 The representation on behalf of Thurrock Council noted that:

"*the environmental assessment did not include consideration of what would appear to be the shortest and most direct pipeline route, which could run parallel to the railway branch-line to Thames Haven. A significant area of land associated with this route has been extensively studied and mitigation proposals well advanced as part of London Gateway logistic park and DPWorld's deep sea port. It is considered that the technical feasibility and likely environmental impacts should be presented for this route. …*

Recommendation

That consideration of approval of the application required the technical feasibility and environmental impacts of a gas pipeline in proximity and parallel to the railway branch-line to Thames Haven is presented as part of the evidence base for the pipeline route selections.

Reason

To ensure the Environmental Statement is supporting by a robust consideration to options which are likely to achieve significant mitigation by avoidance."

GECL Response

3.1.2 As stated in the March 2011 ES Section 5.4, initial analysis indicated that there were a number of potential options available for routing of the gas pipeline and the location of the associated AGI. Furthermore, ES Section 5.5 refers to evaluation of options and selection of the gas pipeline route and associated AGI location, based on consideration of technical, planning, environmental and commercial factors.

3.1.3 Using the same methodology and considerations, the option of following a route through the LG Development was considered and rejected for technical, planning, environmental and commercial factors.

3.1.4 The main technical, planning, environmental and commercial factors why following a route through the LG Development was rejected are as follows:

Technical

- During the construction phase of the LG Development (which could be for a period of 10 years or more) there may be a greater risk of third party damage to the gas pipeline due to the increased frequency of construction activities within the LG Logistics and Business Park site.
- The gas pipeline route is likely to be under tarmac / concreted areas which would mean conventional 'over-the-pipeline' inspection techniques may not be able to be utilised on sections of the pipeline route to provide accurate information on its condition.

Planning

- The LG Development has outline planning consent which ensures build out flexibility. The proposed gas pipeline infrastructure would impact negatively on the economic build out of the LG Development, particularly the LG Logistics and Business Park. For example, the detailed design and build of the gas pipeline are most likely to occur prior to the finalisation of the design of the LG Development. As a consequence, a gas pipeline could impinge materially on the LG Logistics and Business Park's ability to optimise its layout, which would impair flexibility in the development / layout, siting of buildings and employment creation.
- It is noted that the existing aviation fuel pipeline which runs through the LG Development site is be moved to maximize the build out potential of the LG Logistics and Business Park and hence optimise the number of employment opportunities.

Environmental

- In normal practice, gas pipelines are, where possible, routed away from residential or developments employing large numbers of people.

Commercial

- Development of a gas pipeline within the LG Development would give rise to an increase in costs as it would need to be reinforced to take account of HGV crossings and / or train movements. Additionally, the development costs of the LG Logistics and Business Park would increase where roads need strengthened as a result of the gas pipeline.
- Maintenance or repair of the gas pipeline at a future date could impair the operation of the LG Logistics and Business Park which is predicted to be a major employment centre within Thurrock.

Pipeline and Ancillary Features Proposal

Thurrock Council Representation

3.1.5 The representation on behalf of Thurrock Council noted that:

"*the proposed construction of the gas pipeline through the Local Wildlife Areas Stanford Warren Wetland and Stanford Warren Meadow is to be via open cut trenching. It is considered that this method of construction will generate unacceptable harm to the environment and sensitivity of the area. …*

Recommendation

It is recommended that the complete pipeline route between London to Southend Railway Crossing RLX1 and Wharf Road RDX 2 should constructed by Horizontal Directional Drilling

Reason

To safeguard the value and character of Local Wildlife Reserves"

GECL Response

3.1.6 There is an inconsistency between March 2011 ES Table 5.1 (Crossing Schedule) and the associated Figure 5.3a. Table 5.1 notes that the crossing technique for DX 1 (after RLX 1) is Horizontal Directional Drill (HDD) and Figure 5.3a states that the crossing technique for DX 1 is Open-Cut.

3.1.7 The information presented in Table 5.1 is the information on which the ES is based, which assumes that a HDD crossing technique will be employed across the Stanford Warren Nature Reserve. Therefore, for clarity, the reference in Figure 5.3a to DX 1 being Open-Cut should be treated as being deleted.

4 CONSTRUCTION METHODS AND OPERATION

4.1 Response to Oikos Storage Ltd (Agent: Adams Hendry)

Oikos Storage Ltd Representation

4.1.1 The representation on behalf of Oikos Storage Ltd. (Agent: Adams Hendry) of 21/4/2011 stated that:

"*The Environmental Statement that accompanies the application does not explain how the new gas pipeline will cross Oikos' oil pipeline. The generic options that are presented are insufficiently detailed for us to comment. Given that this is an application with an environmental statement, we are somewhat surprised to see that this important matter is intended to be left for post-consent resolution. Oikos considers this to be an unacceptable position and believes that it is in the interests of all parties that the matter is properly dealt with before planning consent is issued.*

Our recent experience of third-party crossings of our pipeline confirms our views that such operations are not necessarily straightforward. It is essential that Oikos approve the risk management processes applied so that we can be sure that there will be no damage to our pipeline, or interruption to our operations, and that environmental risks will be minimised. Our approach is necessarily cautious, and we hope that our view will be understood and shared by the planning authority. It seems to us that the environmental effects of the development cannot be said to have been properly assessed if the methodology for the crossing has not been established and we do not believe this is a matter that can be legitimately be dealt with by a condition on a planning permission.

In conclusion, is also important that Oikos are consulted before any exploratory works are undertaken in proximity to our pipeline, and informed of construction methods that may affect it prior to any Contract being awarded."

4.1.2 Subsequently, after meeting with Oikos, its agent has restated its opinion the information explaining the crossing location and construction method is insufficient to enable Oikos to comment on the acceptability of the proposals. Oikos has requested GECL to provide a detailed scope of the geotechnical investigations for its agreement and has sought confirmation from GECL that it will closely involve Oikos in the ensuing process of designing the crossing. In particular, Oikos wishes to be notified of and have the opportunity to comment on:

- "*Service routes and crossing points for both mechanical and electrical services;*

- *Method of construction to be applied for the crossing of the pipeline, for both mechanical and electrical services; and*
- *Detailed method statements and risk assessments for the various works, including details on monitoring vibration and settlement in close proximity to the Oikos pipeline*".

4.1.3 In addition, Oikos seeks an assurance that access to its pipeline be maintained at all times.

GECL Response

4.1.4 The March 2011 ES Section 6 (Construction Methods and Operation) has been updated to provide Further Information on typical crossings as requested.

4.1.5 The updated ES Section 6 is provided in Appendix C.1. In addition, the likely significant environmental impacts of typical crossings techniques are presented and assessed in the Table in Appendix C.2.

4.1.6 Prior to undertaking physical works near Oikos' crossing point, GECL will consult with Oikos and take into account responses relating to:

- Service routes and crossing points for both mechanical and electrical services;
- The method of construction at the crossing;
- Risk Assessments; and,
- Method Statements (including vibration and settlement monitoring).

4.1.7 Additionally, Oikos will have access to its pipeline during works near or at its crossing.

4.1.8 No works will be undertaken at or near Oikos' pipeline (where the proposed gas pipeline would cross it) without first discussing and agreeing such work and the methods to be employed with Oikos.

4.1.9 GECL points out that it has an excellent health and safety record both in construction and operations of gas pipelines, consistent with UK energy sector experience. Furthermore, GECL is to adopt industry standards as is its norm when undertaking pre-construction and construction works. This is further explained at Appendix C.1.

5 LAND USE

5.1 Response to Shell (Agent: Jones Lang LeSalle)

5.1.1 Shell, through its Agent Jones Lang LaSalle (JLLS), wrote to TTGDC on 13/04/2011 in respect of application 11/50286/TTGFUL stating that the boundary and positioning of the proposed works would require the use of land within the ownership of Shell and that it objects to the use of its land. The letter from JLLS includes reasons for objection on the basis of the:

- Health and Safety impact of the dense phase CO_2 pipeline on the Shell land holding;
- Health and Safety impact of the electricity cables on the Shell land;
- Impact of rights of access associated with the wayleaves on Shell land and safety risks associated with gas pipeline maintenance; and
- Impact of the wayleaves on Shell's long term access rights to the new Shell jetty via the LG Development Gate 3 Access Road.

5.1.2 In addition, the letter to TTGDC stated that the date in the notice under Articles 11 and 32 of the Town and Country Planning (Development Management Procedure) (England) Order 2010 was given as 21/04/2011 but, that in JLLS's view, the correct

consultation period was 13/04/2011 (notice was not in fact given under Article 32 as that Article applies to appeals). When submitting the application, notice of the application was sent by [registered post] to Shell and notices erected around the site and advertised in the Thurrock Gazette (25/03/2011) and Yellow Advertiser (24/03/2011).

5.1.3 GECL met with the Shell team on 27/05/2011 and, since then, has engaged with Shell in constructive discussions to address matters raised. Going forward, GECL proposes to meet with Shell regularly to keep the Company informed of the progress on the GEC.

5.1.4 GECL's response to Shell to each of the matters raised in Shell's objection letter is summarised below. The text in italics is quoted from Shell's objection letter.

Health and Safety of the CO2 Pipeline

Shell Comment

5.1.5 The Shell comment is as follows:

"*The Health and Safety impact of the dense CO2 pipeline on the Shell UK Ltd land holding*."

GECL Response

5.1.6 GECL, as part of its Section 36 Consent application, has submitted a Carbon Capture Feasibility Study (CCR Feasibility Study) to DECC (February 2010). The CCR Feasibility Study was prepared to address the Government's Guidance (November 2009) on Carbon Capture Readiness for new power stations over 300 MW.

5.1.7 One principal requirement of a CCR Feasibility Study is to demonstrate that there is sufficient land available for the retrofitting of carbon capture technology should this become a requirement and / or be technically and commercially proven on a large scale. There is no current application by GECL for carbon capture equipment and / or a CO_2 pipeline to be installed. In order for GECL to construct carbon capture equipment and / or a CO_2 pipeline, any future application will include prior consultation with Shell and other stakeholders.

5.1.8 With regard to the Health and Safety impact of dense phase CO_2, the CCR Feasibility Study was prepared on a worst case basis and assumes that dense phase CO_2 will occur at the GEC site. Currently, CO_2 (or dense phase CO_2) is not covered by the Control of Major Accident Hazard (COMAH) Regulations and is not deemed to be a hazardous substance. This may change in the future.

5.1.9 Based on current information, dense phase CO_2 may not be implemented at the GEC site. For example, Iberdrola's CCS Demonstration Project at Longannet in Fife (just to the north of Edinburgh), Scotland will utilise gaseous phase CO_2 and transport the CO_2 in this phase via an on shore transportation pipeline to the St Fergus Gas Terminal (some 150 miles away) where it will then be compressed to dense phase CO_2 for off shore pipeline transportation.

5.1.10 In the event that dense phase CO_2 is required and GECL requires to make an application for carbon capture equipment and / or a CO_2 pipeline, GECL will address the health and safety requirements in its design and ensure appropriate consultation is undertaken (including but not limited to consideration of safety zones, prevailing health and safety regulation, the proximity of Shell's Land and other buildings and the LG Development).

5.1.11 In addition, an assessment of the likely significant environmental effects associated with the implementation of CCS at GEC was included in Section 18 of the March 2011 ES. As stated in Section 9 of this ES FID, an updated March 2011 ES Section 18 is provided in Appendix E.1.

Health and Safety – Electricity Cable

Shell Comment

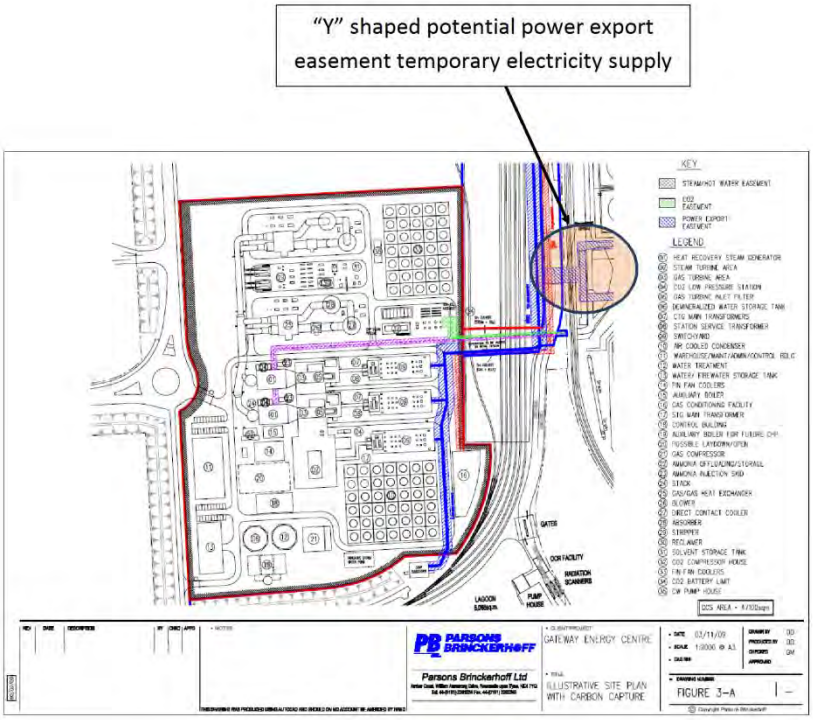
5.1.12 The Shell comment is as follows:

"*The Health and Safety impact of the 144kv electricity cables on the Shell UK Ltd land holding*."

GECL Response

5.1.13 GECL understands that this comment relates to Figure 3A of the CCR Feasibility Study (February 2010) which goes through Shell's Land as annotated in Insert 1. This refers to a potential route for the export of electricity for a temporary private supply from the existing CECL Power Station to the LG Development.

INSERT 1 – FIGURE 3A OF THE CCR FEASIBILITY STUDY



5.1.14 There is no proposal to export electricity from GEC using this route. The potential routes for exporting electricity from GEC to the National Grid are shown in Appendix E.1. It is noted that all routes shown in Appendix E.1 follow the same easement to the east of the GEC site running north until they reach the A1014 (The Manorway).

Use of Shell Land

Shell Comment

5.1.15 The Shell comments is as follows:

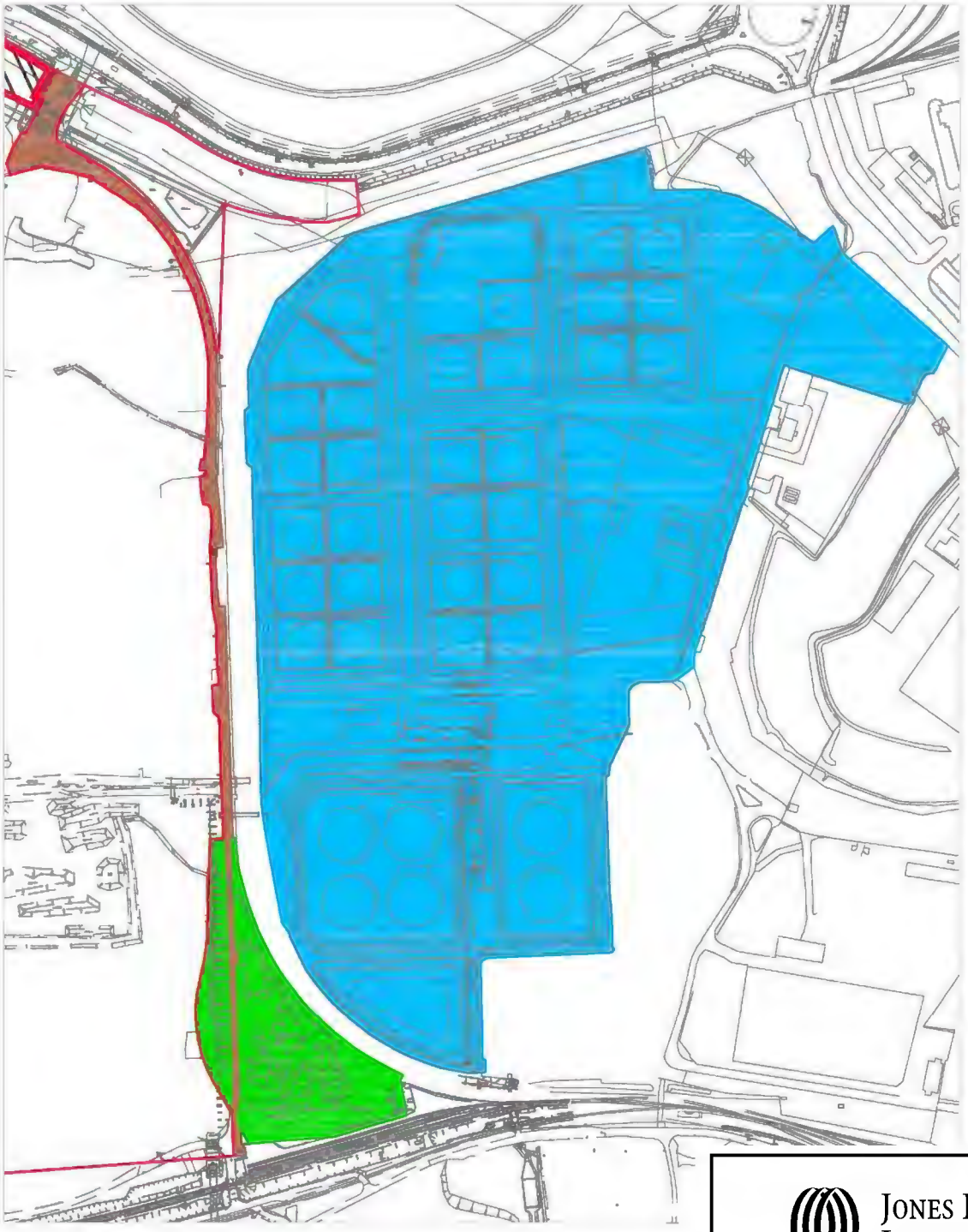
"*We note that the boundary and positioning of the proposed works in relation to the Shell UK landholding will result in the proposal requiring the use of land under the ownership of Shell UK Ltd. Please refer to the site plan attached. We object to the use of Shell UK Ltd land for this proposal*."

GECL Response

5.1.16 GECL accepts Shell's observation.

5.1.17 Having clarified the position with Shell that the proposed gas pipeline is anticipated to follow the route set in plan "Indicative Gas Pipeline Route (Shell)", GECL undertakes to exclude the areas marked in blue and green on the London Gateway site plan reference LGW-008-166 rev.5. These areas marked in the following figure (DP World extract to show Shell Land) in blue, brown and green and are to be known as "Shell's Land".

5.1.18 The exclusion of the blue and green areas on the London Gateway site plan reference LGW-008-166 rev.5 makes no difference to assessment of environmental effects described in the March 2011 ES.



KEY:

- PARK LAND
- MANORWAY LAND
- TANK FARM
- GATE 3 ACCESS ROAD
- BLUE LAND
- NEW BITUMEN LAND
- OLD BITUMEN LAND

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TEL: (020) 7852 4122
www.joneslanglasalle.co.uk/planning

Title: DP World extract to show Shell Land		
Job No: 1000091408	Client: Shell UK Ltd	
Plan: JLL1		
Date: 21.06.2011	Scale: NTS	Drawn By: ALJ

Gas Pipeline Maintenance

Shell Comment

5.1.19 The Shell comment is as follows:

"*The impact of rights of access associated with the wayleaves at the Shell UK Ltd land holding, including its Health and Safety risks to the Shell operation…..as a result of gas pipeline maintenance*."

GECL Response

5.1.20 GECL considers that the construction and operations of the gas pipeline will not impact on Shell's access over Shell's Land (green and blue in the above Figure). This consideration is supported by the processes set out in the Environmental Statement (e.g. use of Horizontal Directional Drilling (HDD) to go under Gate 3 as well as the A1014 (The Manorway) and maintenance works being non-intrusive (unless there is a major repair operation which is very infrequent)).

5.1.21 GECL proposes to utilise Gate 3 for construction of GEC and needs both Gate 3 and the A1014 (The Manorway) to remain operational (as does the Highways Authority). In addition, GECL undertakes to ensure that appropriate contingency planning is in place prior to construction commencing to cover the scenario of an event occurring during construction that results in the closure of the A1014 (The Manorway) and / or the Shell Land (marked in brown in the above Figure). Shell, London Gateway and Petroplus will be consulted on such contingency measures, including the provision of temporary alternative access.

5.1.22 Terms for access across Shell Land (marked in brown in the above Figure) will be agreed with Shell at a future date on the basis that such rights cannot be granted by London Gateway. In any event, GECL agrees to keep Shell informed of the gas pipeline route and the proposed use of the Shell Land (marked in brown in the above Figure) prior to and during construction. Additionally, GECL must comply with London Gateway's site regulations.

5.1.23 GECL points out that InterGen has an excellent construction, operational and health and safety record, consistent with the UK energy industry including its experience with similar gas pipelines.

5.1.24 GECL agrees to keep Shell informed of progress on the project and consult it on the construction works and methods for those areas of the pipeline in the proximity of Shell's Land once a contractor has been selected. Moreover, GECL will keep Shell informed of any future intrusive maintenance works on the gas pipeline should such works arise (which is unlikely).

5.1.25 Access will be maintained at all times and there will be no effect on health or safety.

New Shell Jetty

Shell Comment

5.1.26 The Shell comment is as follows:

"*The impact of the wayleaves on Shell's long term access rights to the New Shell Jetty via the Gate 3 Access Road*."

GECL Response

5.1.27 As above, the construction and operation of GEC will not impinge on Shell's Gate 3 access road rights.

5.1.28 Additionally, any future application for CCS including a CO_2 pipeline will take full cognisance of Shell's Land and access rights and not hinder them. Access will be maintained at all times and there will be no effect on health or safety.

Consultation

Shell Comment

5.1.29 The Shell comment is as follows:

"*We note that the consultation date…on the timetable*."

GECL Response

5.1.30 GECL stipulated a period for consultation of 21 April 2011, as agreed with TTGDC, to coincide with TTGDC's own public notification. This extended consultation period allowed landowners / tenants extra time to respond.

5.1.31 GECL has considered the contents of the Objection Letter. TTGDC will have the opportunity to consider the contents of the Shell objection letter.

6 LANDSCAPE AND VISUAL

6.1 Response to Thurrock Council

AGI Landscape Scheme and Design Details

Thurrock Council Representation

6.1.1 The representation by Thurrock Council noted that:

"*The proposed site of the AGI plant lies on upper slopes of the escarpment that overlook the Mucking marshes. The ridge line settlement of Stanford le Hope and the artificial landscapes of St Clere's golf course are screened from skyline views from lower elevations to the south. Tree and overgrown hedgerows intermittently line the road and rail transport routes which swing though the area. An active waste landfill site at Mucking has previously blighted the character of the area. Although the artificial landforms of the restoration landscape alters the historic character of view to the estuary, the Thurrock Thameside Nature Park proposal to manage tree lines lakes and rough grassing land will contribute to the character of a tranquil rural coastline. Panoramic views from footpath (PROW41) and the ridgeline which extending south west from Stanford le Hope, are expected to become increasingly valued as the development of London Gateway and DPWorld will visually block view of the river from elevated ridgeline views to the east.*

The two over head power lines, running east to south west, are a conspicuous detractor within the relatively small scale landscape features of the immediate surroundings of the proposed AGI site. The artificial green security fenced box of the existing AGI plant at Butts Lane is considered to be a recognisably industrial feature set into a belt of vegetation which extends across the southern extent of St Clere's golf course".

GECL Response

6.1.2 The March 2011 ES shows in Figures 11.7 and 11.8 photographs of the existing AGI for the CECL Power Station taken from the private access track (in views from the south) and St Clere's Golf Course (in views from the north).

6.1.3 In addition, the March 2011 ES shows in Figures 11.9 and 11.10 photographs of the existing AGI for the CECL Power Station taken from Footpath 41 (to the south of the existing and proposed AGI).

6.1.4 Views from Footpath 41 were not included in the landscape and visual impact assessment in Table 11.9 and 11.10 in the March 2011 ES Section 11; it should be noted that the viewpoints were agreed with TTGDC prior to assessment. The Table below provides the landscape and visual impacts during construction and operation for users of Footpath 41. The methodology described in the March 2011 ES Section 11 has been employed.

SUMMARY OF LANDSCAPE AND VISUAL IMPACTS FROM FOOTPATH 41

Location	***Receptor***	***Sensitivity***	***Description of Impact***	***Magnitude***	***Significance***
Footpath 41	Recreational Users	Medium	During construction, there will be direct views of the construction works, including the AGI, at close proximity. The impact could be partially mitigated by screening[1].	High	Major Temporary Adverse
Footpath 41	Recreational Users	Medium	During operation, there will be views of the AGI. Screening will be provided in the form of landscaping.	Negligible, due to the screening which will be provided.	None.

[1] *Details are provided in March 2011 ES Section 11 Paragraph 11.5.4.*

6.1.5 In addition, the March 2011 ES notes that, based on a site walkover and Figures 11.7 to 11.10, it is likely that the two AGIs would provide each other with complementary shielding, in the form of their associated landscaping. Utilising this approach, the placement of the two AGIs is beneficial as the provision of the landscaping at the two AGIs provides mutual screening.

Thurrock Council Representation

6.1.6 In addition, the representation by Thurrock Council noted that:

"*The proposed AGI plant is significantly larger than the existing AGI plant. Locating the proposed AGI plant within the arable fields to the south of the access track is predicted to significantly increase the likely impacts to landscape character and visual amenity. The proposed screening will assist to mask the built features overtime and filter view of the open face of the existing AGI plant. The artificially square block of vegetation extending into the arable field is, however, considered to be incongruous to the small scale rolling slopes.*

It is recommended that the vegetation block be extended to form a sweeping lens of vegetation along the access track and farming tack beyond. It is predicted that this would also assist management of the crop by integrating the square intrusion into more efficient farming vehicle movements

Recommendation

That an approval of the proposed AGI plant at Butts Lane is subject to further approval of the landscape scheme including the extent, layout and specification of a vegetation buffer and agreement of long term management.

Reason

To safeguard the landscape character and visual amenity of the local area"

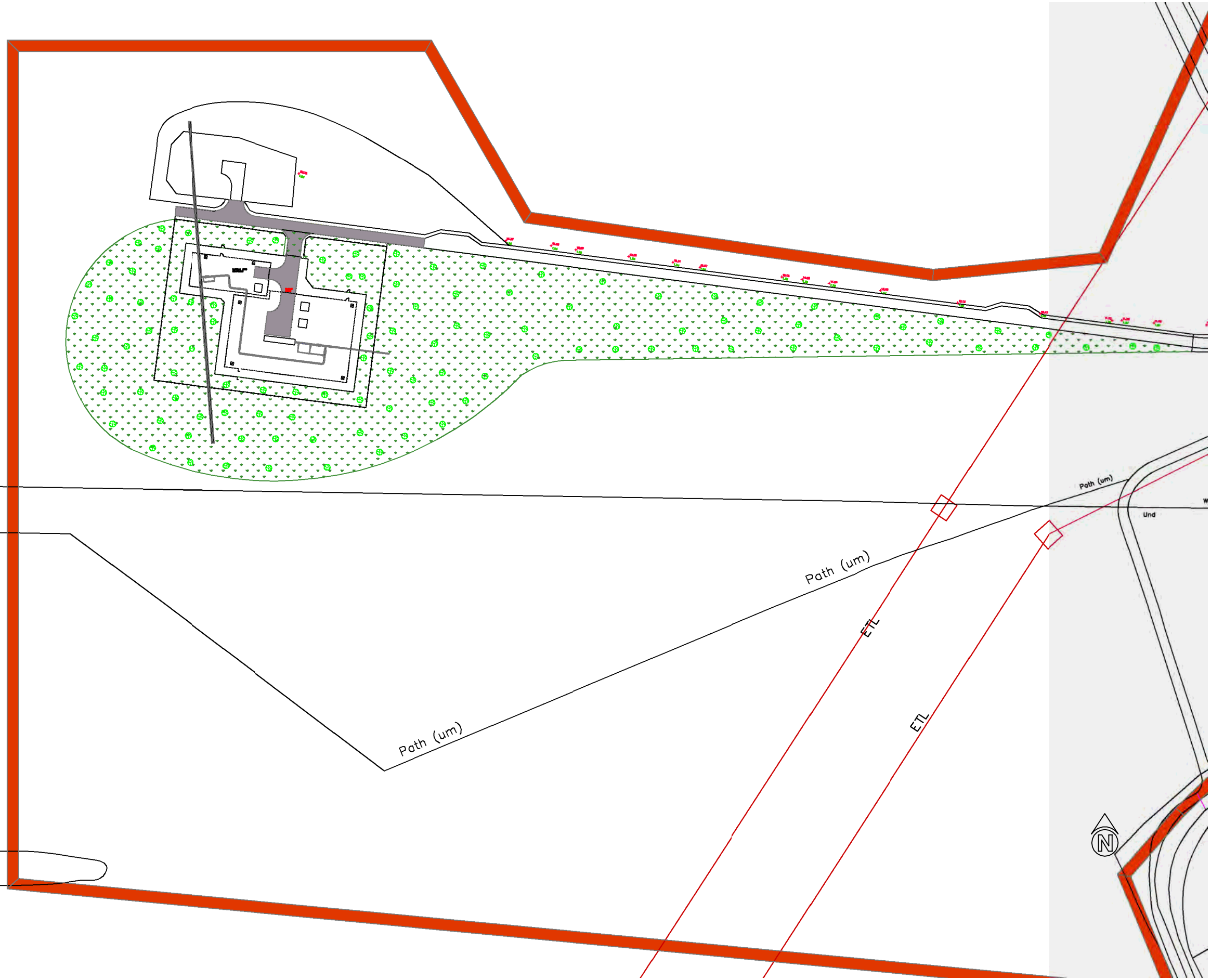
GECL Response

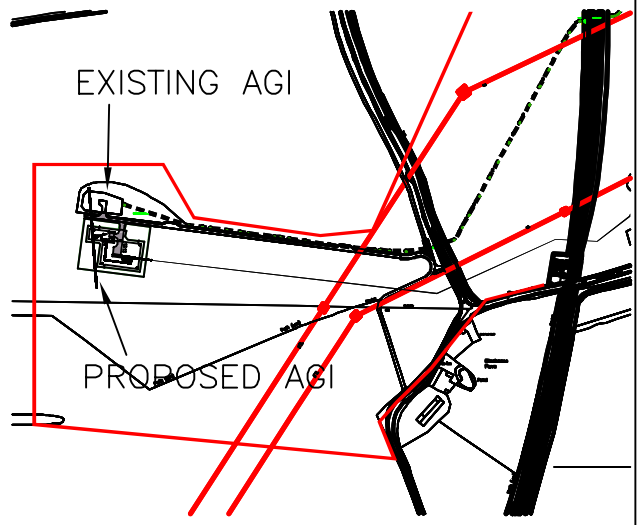
6.1.7 Further to the March 2011 ES, proposals for landscaping, including the sweeping lens of vegetation, are shown in Figure 1. The proposals for landscaping, and its long term management, will be subject to agreement with TTGDC (in consultation with Thurrock Council).

6.1.8 The information provided in the March 2011 ES Section 6 (Paragraph 6.2.12) and Section 11 (Paragraphs 11.6.3 to 11.6.5) regarding Landscaping and Biodiversity Enhancement provide further information.

6.1.9 As the proposals for landscaping are not substantially changed and are still subject to approval, the information on Figure 1 is not deemed to make any difference to the assessment of environmental effects described in the March 2011 ES.

Project Number: 63958 | Drawing Number: FIGURE 5.2a | Revision:





LOCATION PLAN

Rev	Date	Description	By	Chk	App
1	27.07.11	Drawing Updated	MS	EA	EA

Notes:

PARSONS BRINCKERHOFF
125 YEARS
Amber Court
William Armstrong Drive
Newcastle upon Tyne NE4 7YQ
Tel: 44-(0)191-226-2000
Fax: 44-(0)191-226-2104

Client: INTERGEN

Project: GATEWAY ENERGY CENTRE GAS PIPELINE AND AGI

Title: INDICATIVE LAYOUT OF THE AGI INCLUDING LANDSCAPING

Drawn: MS	Checked: EA		
Designed: EA	Approved: EA		
Date: 27/07/2011	Scale: NTS	A3	Sheet:
Project Number: 63958	Drawing Number: FIGURE 1		Revision:

File Name: K:\Projects\Coryton - Thames Power\Current\G.E.C GAS PIPELINE AND AGI REPORT\Planning Application\Figure 1.dwg
Login: Stenhoff, Mark
Plot Date: 27/07/2011 11:33:06

Thurrock Council Representation

6.1.10 In addition, the representation by Thurrock Council noted that:

"*The description of 'pailing' security fencing raises concerns. The visual intrusion of security fencing is significantly altered by the detail design and finish colour. The assessment of predicted harm and recommendation above are based on replicating a similar system of security weld-mesh fencing with green finish of the existing AGI plant*

There appears to be up to six posts to support a mixture of CCTV and lighting on the proposed site. The increase of vertical structures and light intrusion into the dark nightscape raises concern. The detail design of these features and specification of finishes can appreciably alter the visual intrusion. The assessment of predicted harm and recommendation above are based on replicating a similar design on CCTV and lighting of the existing AGI plant. The reflective nature of the existing features is apparent and consideration of alternative surface finish of the proposed structures is recommended

Recommendation

That an approval of the proposed AGI plant at Butts Lane is subject to further approval of detail design and specification of fencing, lighting and CCTV structures.

Reason

To safeguard the landscape character and visual amenity of the local area."

GECL Response

6.1.11 GECL agrees with this approach, and note that the detailed design and specification of fencing, lighting and CCTV structures can be reserved by condition and that details will be submitted to and approved by the Local Planning Authority pursuant to such a condition. The assessment of effects contained in the March 2011 ES takes account of the fact that such a condition can be imposed.

Pipeline and Ancillary Features Proposal

Thurrock Council Representation

6.1.12 The representation by Thurrock Council noted that:

"*The importance of the open character of the Greenbelt, to retain the historic character of ridgeline settlement set above costal marshes and the separation of large scale coastal industry, is apparent in long distant panoramic views from the ridgeline. The views from One Tree Hill and country parks of Langdon Hills are prized as the most extensive elevated views in Essex*."

GECL Response

6.1.13 Assessment of the proposed gas pipeline and associated AGI in terms of the Green Belt are presented in the Planning Statement (March 2011).

6.1.14 The landscape and visual impact assessment presented in the March 2011 ES Section 11 did not consider views from One Tree Hill / Langdon Hills County Park. However it is noted that a viewpoint from this location was assessed as part of the GEC ES FID (December 2010).

6.1.15 Information from the GEC ES FID (December 2010) notes that:

- The viewpoint is elevated, looking south-east towards the GEC site across Corringham Marshes and Fobbing Marshes. The existing transmission lines, CECL Power Station and Coryton Oil Refinery are clearly visible.

- The receptor sensitivity is deemed to be 'High' as it represents the views of recreational users.
- With the development of GEC, the magnitude of change to the existing view would be 'Negligible' as GEC would only be visible in the distance and would be seen in the context of the existing transmission lines, CECL Power Station and Coryton Oil Refinery.
- The impact to the receptor would be 'Moderate / Minor' and Not Significant. However, given the nature of the view the impact is more likely to be 'Minor'.

6.1.16 Given this conclusion (in addition to the temporary nature of construction and the likely 'low-level' of construction) it is considered that the landscape and visual impact of the development of the gas pipeline and associated AGI to view from One Tree Hill / Langdon Hills Country Park is also Not Significant.

7 LAND USE / GEOLOGY, HYDROLOGY AND HYDROGEOLOGY

7.1 Response to Thurrock Council

Pipeline and Ancillary Features Proposal

Thurrock Council Representation

7.1.1 The representation by Thurrock Council noted that:

"*The potential impact to water quality by the construction of the gas pipeline through the arable farmland and managed coastal grazing area is considered to pose a risk to the historically sensitive landscape character of the area. Landform features and habitat vegetation are considered to be particularly vulnerable to water control measures*".

GECL Response

7.1.2 March 2011 ES Section 13 presented the environmental impact assessment with regards to Land Use / Geology, Hydrology and Hydrogeology. Paragraphs 13.5.9 to 13.5.20 and 13.5.25 to 13.5.27 deal with impacts to Hydrology / Surface Water / Hydrology. Paragraphs 13.6.14 to 13.6.20 deal with mitigation measures to be employed during construction of the gas pipeline and associated AGI. Based on this information, March 2011 ES Section 13.7 (Assessment of Residual Impacts) states that "*provided the confirmed and specific mitigation measures are followed, it is not anticipated that there will be any residual impacts arising from the development of the gas pipeline and associated AGI … . Therefore the residual impact associated with the gas pipeline and associated AGI are not anticipated to be significant at any of the identified sensitive receptors*".

7.1.3 Further to this, GECL is already familiar with most owners / operators along the proposed gas pipeline route as, for the most part, the route will run parallel to the existing CECL Power Station gas pipeline. Accordingly, once the design of the gas pipeline and associated AGI is nearing finalisation, this will be agreed with the Local Authority and the relevant owners / operators. This will ensure the viability and sustainability of the remediation / enhancement works and their long term management in conjunction with agreement from interested parties.

8 CULTURAL HERITAGE

8.1 Response to ECC (Historic Environment Branch)

ECC Representation

8.1.1 The representation by ECC (Historic Environment Branch) noted that:

"[The ES submitted with the application for planning permission] *fails to appropriately assess the impact of the proposed development on the historic environment*"

Therefore:

"*Prior to any decision being made on this application, further work is needed on upgrading the historic environment assessment. … The Historic Environment Branch recommendation is that no decision is made on this application [for planning permission] until the Historic Environment impacts have been appropriately assessed and the Historic Environment section resubmitted*".

GECL Response

8.1.2 Based on this representation, Oxford Archaeology was commissioned to undertake a Heritage Assessment. This is provided in Appendix D.1.

8.1.3 The Heritage Assessment replaces the March 2011 ES Section 15 (Cultural Heritage).

9 INDIRECT / SECONDARY AND CUMULATIVE IMPACTS

9.1 Response to Thurrock Council

Pipeline and Ancillary Features Proposal

Thurrock Council Representation

9.1.1 The representation by Thurrock Council noted that:

"*The extent of pipeline works will be apparent in middle and long distance views across the coast. It is noted in paragraph 18.5.13, that construction impacts are predicted to be reduced by staged works, however the requirement of testing the complete pipeline suggests open cut trenches and access points would remain open until the pipeline is complete and tested. The landscape and visual impact of disturbed ground and temporary structures would therefore not be shortened by staged works along the route*

Recommendation

That a mitigation and enhancement measures of the proposed development are complimentary to, and form part of, Landscape and Environmental Mitigation Schemes approved in relation to the Gateway Energy Centre and associated development by the applicant

Reason

To safeguard the landscape character and visual amenity of the local area. To ensure coordination and design, construction and remediation works, minimises harm and maximises benefit to the strategic and local Greengrid".

GECL Response

9.1.2 GECL agree and will endeavour to ensure that the mitigation and enhancement measures of the proposed gas pipeline and associated AGI are complementary to those of GEC and the electrical connection (which is still to be developed).

Cumulative Impacts

9.1.3 The representation by Thurrock Council noted that:

"*The description and assessment of likely impacts are of great assistance to consideration of this application. However it is considered that the impacts of an electrical substation and sealing end plant structures, associated with an electrical connection, are not sufficiently accounted for.*

It is noted that the assessment of predicated impacts of overhead electrical connections are to be mitigated by association with existing overhead routes. It is considered that in areas where the scale of landscape is reduced by local features, that the additional width, of the over head electrical route is likely to generate significant landscape and visual harm.

The impact of the proliferation and increased clutter of large scale vertical features in the coastal zone, including pylons, sealing end electrical connections, proposed power station stacks and proposed DPWorld cranes, is considered to generate significant harm.

The proposed gas pipeline is predicted to be in close proximity of other associated infrastructure works by the applicant, such as the electrical connection to a proposed substation in East Thurrock. Separation of the construction of these developments, by distance or timing would no doubt be advantages in terms of contract administration; however, such separation is predicted to generate significant environmental harm, by extending the areas disturbed by construction or consecutive reworking or interventions that impact landscape elements over time.

Recommendation

That the detail design and construction / remediation programme of works for proposed gas pipeline is integrated with associated works of Gateway Energy Centre, by the applicant, such as electrical connection works to a substation.

Reason:

To minimise cumulative impacts of associated major infrastructure projects serving Gateway Energy Centre power station".

GECL Response

9.1.4 As noted in Section 9.2 of this ES FID, the March 2011 ES Section 18 has been updated. This has taken into account the potential indirect / secondary and cumulative impacts associated with the electrical connection, including the proposed National Grid Sub-station and connection to the existing Rayleigh to Tilbury overhead line.

9.1.5 Further to this it is noted that normal practice when locating gas and electrical connections is to maximise the separation distance between them to reduce the mutual interference and mitigate the electrical safety risks.

9.1.6 The minimum separation distance between gas pipelines and the earth associated with HV electrical connections is normally taken to be 15 m. The reason for having a minimum recommended separation distance is for health and safety reasons, that is:

- To reduce the touch potential risk to personnel working on the gas pipeline; and,
- To minimize the level of induced voltage to ensure the integrity of the gas pipeline.

9.1.7 In terms of the touch potential risk to personnel working on the gas pipeline, the 15 m minimum separation distance is intended to avoid the risk of a hazardous voltage being induced on the gas pipeline if a fault occurs on the HV electrical connection system. This can occur if the gas pipeline is too close to the HV electrical connection system. In this case there is a risk of harm if an exposed surface of the gas pipeline is inadvertently touched.

9.1.8 In terms of the integrity of the gas pipeline, the 15 m minimum separation distance will also reduce the risk of AC induced corrosion of the gas pipeline caused by the induced voltages from the HV electrical connection. Over time this could lead to a

reduction of the gas pipeline wall thickness, if it is not effectively controlled and monitored. This could result in gas leakage under extreme circumstances and the associated risk of fire / explosion.

9.1.9 However, it is possible to have a shorter minimum separation distance where space is a constraint, for example at points where there is congestion caused by existing underground pipelines / services / utilities / other infrastructure. In these instances the gas and electrical connections are subject to comprehensive mathematical modelling studies to determine appropriate schemes of mitigation to minimise induced voltage / other interactive effects between the systems. This ensures both the health and safety, and integrity of the installed systems.

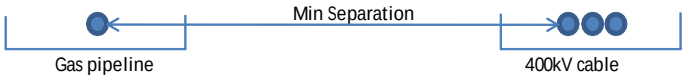
9.1.10 These studies, for example, could include appropriate systems of mitigation to address the correct level of:

- Cathodic protection;
- AC corrosion mitigation systems;
- Pipeline to power line separation;
- Powerline configuration;
- Pipeline earthing; and
- Culverting.

9.1.11 Typically the costs for implementing the mitigation of induced voltages on a gas pipeline (where the gas pipeline is laid in close proximity to a HV electrical connection) may be in the order of double the installation costs compared to the case where the gas and electrical connections are installed separately. Therefore, typically, where gas and HV electrical connections are laid in close proximity these occasions are limited to points where there is congestion caused by existing underground pipelines / services / utilities / other infrastructure along any common route. It is very rare for gas and HV electrical connections to be laid in close proximity over a full route otherwise project economics can be impacted materially.

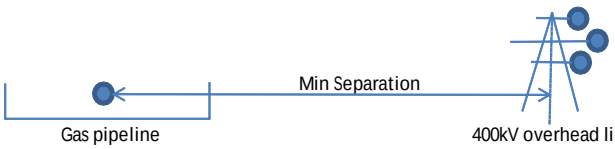
9.1.12 In terms of easement widths, the anticipated easements required during construction and operation are illustratively shown in the Cases below. As the form of the HV electrical connection is not currently known, easement widths have been provided for both an underground electrical cable and an over ground electrical cable. However, it should be noted that these are illustrative only at this time and are subject to further design and engineering assessment. The greater the separation, the lower the risk to the gas pipeline system. The full extent of risk can only be determined once detailed mathematical modelling is performed.

Case A - gas pipeline and underground cable in different trenches



	Gas Pipeline	Minimum Separation	400kV Underground Cable
Construction Easement Width	30m	15m	13.6m
Operations Easement Width	7m	15m	8.6m

Case B - gas pipeline and overhead line



	Gas Pipeline	Minimum Separation	400kV Overhead line
Construction Easement Width	30m	15m	100m
Operations Easement Width	7m	15m	100m

9.1.13 Given the need for safety distances as explained above, it may not be practicable to combine the gas and HV electrical connections. In addition, it may not be cost effective. However, as the electrical connection is progressed further, GECL will give consideration to a number of factors, including those relating to: technical (i.e. interactive effects of the gas and electrical connections / the degree of separation needed for health and safety purposes / third party pipeline, services and utilities integrity); planning; environment; land ownership; and commercial.

9.1.14 For the purposes of the ES FID, at Appendix E.1, the indirect / secondary and cumulative impacts have been assessed on a worst case basis. This assumes separate construction corridors for the gas and electrical connections in light of the above.

9.2 Update to the March 2011 ES Section 18 (Indirect / Secondary and Cumulative Impacts)

9.2.1 Based on the Further Information provided in this ES FID, the March 2011 ES Section 18 (Indirect / Secondary and Cumulative Impacts) has been updated. The updated ES Section 18 is provided in Appendix E.1. It should be noted that references to Sections relate to the March 2011 ES.

APPENDIX A

REPRESENTATIONS MADE BY THRID PARTIES TO TTGDC

A REPRESENTATIONS BY THRID PARTIES TO TTGDC

Introduction

The representations made by Oikos Storage Ltd (Agent: Adams Hendry), Shell UK Ltd (Agent: Jones Lang LaSalle), Essex County Council (Historic Environment Branch) and Thurrock Council are shown in:

Appendix A.1 – Representations made by Third Parties to TTGDC

7 St Peter Street Winchester
Hampshire SO23 8BW
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F 01962 877415/844968
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E info@adamshendry.co.uk

Your Ref:
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Project No: OSL/823

Mr Matthew Gallagher
Thurrock Thames Gateway Development Corporation
2nd Floor
Civic Offices (CO1)
New Road
Grays
Essex
RM17 6SL

21st April 2011

Dear Mr Gallagher,

Re: Gateway Energy Centre Ltd Planning Application – Development of an underground gas pipeline and associated above ground installation (AGI)

I write in response to the letter from Dalton Warner Davis dated 23 March 2011 (ref CB/2746D) regarding the planning application submitted by Gateway Energy Centre Ltd for consent to construct an underground gas pipeline and associated above ground installation (AGI). DWD requested that I address my reply to you.

I gather from the information available on the Corporation's website that the applicant proposes to construct a new underground gas pipeline that would cross the GPSS feeder-line north of The Manorway in Thurrock. You should be aware that this feeder-line, which is owned by Oikos, is part of a nationally significant network distributing oil products to key installations.

The Environmental Statement that accompanies the application does not explain how the new gas pipeline will cross Oikos's oil pipeline. The generic options that are presented are insufficiently detailed for us to comment. Given that this is an application with an environmental statement, we are somewhat surprised to see that this important matter is intended to be left for post-consent resolution. Oikos considers this to be an unacceptable position and believes that it is in the interests of all parties that the matter is properly dealt with before planning consent is issued.

Our recent experience of third-party crossings of our pipeline confirms our view that such operations are not necessarily straightforward. It is essential that Oikos approve the risk management processes applied so that we can be sure that there will be no damage to our pipeline, or interruption to our operations, and that environmental risks will be minimised. Our approach is necessarily cautious, and we hope that our view will be understood and shared by the planning authority. It seems to us that the environmental effects of the development cannot be said to have been properly assessed if the methodology for the crossing has not been established, and we do not believe this is a matter that can be legitimately be dealt with by a condition on a planning permission.

In conclusion, is also important that Oikos are consulted before any exploratory works are undertaken in proximity to our pipeline, and informed of construction methods that may affect it prior to any Contract being awarded.

Yours faithfully,

Martin Hendry
Director

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Your Ref:
Our Ref:
Project No: OSL/823

Chris Brake
Dalton Warner Davis LLP
21 Garlick Hill
London
EC4V 2AU

27th June 2011

Dear Chris

OIKOS STORAGE LTD.
PLANNING APPLICATION BY GEC FOR CONSENT FOR AN UNDERGROUND PIPELINE (APPLICATION REF: 11/50286/TTGFUL)

Further to our meeting on 25th May, I write as promised to let you have a note of the measures on which Oikos need to be satisfied if they are to withdraw their objection to GEC's planning application.

You will recall that the general context is that the Town and Country Planning (Environmental Impact Assessment) Regulations 1999 require an Environmental Statement (ES) to contain data to identify and assess the main effects that the development is likely to have on the environment. Unfortunately, the ES submitted with the application does not provide adequate information about the effects the GEC pipeline may have when crossing the Oikos Pipeline, which, based on experience of similar projects elsewhere, are likely to be significant. The information explaining of the crossing location and the construction method is insufficient to enable Oikos to comment on the acceptability of this element of the proposals.

It was apparent from our meeting that GEC generally acknowledges the limitations of its submission in this respect and plans further geotechnical work to finalise and detail their plans.

To facilitate progress, Oikos have the following requests, which it believes will provide it with the security it needs that the GEC's proposals can be implemented without detriment to the company's pipeline, which is fundamental to the operation of Oikos's storage business. At the outset, the company asks to be provided with a detailed scope of the geotechnical investigations, for its agreement, and confirmation from GEC that Oikos will be closely involved in the ensuing process of designing the crossing. For its part, Oikos undertakes to cooperate with GCE and not unreasonably delay or withhold its agreement

In particular Oikos wishes to be notified of and have the opportunity to comment on the following matters:

- service routes and crossing points for both mechanical and electrical services;
- method of construction to be applied for the crossing of the pipeline, for both mechanical and electrical services, and
- detailed method statements and risk assessments for the various works, including details on monitoring vibration and settlement in close proximity to the Oikos pipeline.

ADAMS
HENDRY

In view of the potential severity of the consequences were the operation of the pipeline to be disrupted, Oikos asks that, after planning permission is granted, GCE enters into an agreement with Oikos to give legal effect to the following assurances:

i. Oikos's rights of access to the pipeline to be maintained at all times, including during any periods of survey work and throughout the construction phase. This is to ensure that OSL's on-going maintenance and operational requirements can be met.

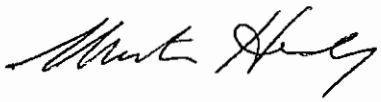
ii. GEC to cover the costs for any specialist resources that Oikos may need to employ to oversee any critical activities.

iii. GEC to be responsible for any costs incurred as a result of any damage of the pipeline. This would include costs as a result of the loss of operation.

As we move ahead, there may be other matters that could usefully be added to this list.

I trust this information clarifies Oikos's position, and their commitment to resolving the outstanding issues relating to the application. Oikos would be happy to meet with you to discuss further any of the points outlined above.

Yours sincerely,



Martin Hendry
Director

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Your ref
Our ref 1000091408.110411.QRC
Direct line 02073995409

guy.bransby@eu.jll.com

BY POST AND EMAIL
Matthew.Gallagher@thurrocktgdc.org.uk

13th April 2011

Dear Mr Gallagher

Town and Country Planning Act 1990
Application Ref: 11/50286/TTGFUL ("Application")
Corridor of land extending from the Gas National Transmission System (No. 5 Feeder) to the Gas Reception Facility at the proposed Gateway Energy Centre, The Manorway, Coryton, Essex, SS17 9PD ("Site")
Objection by Shell UK Limited ("Shell")

We act for Shell UK Limited, the owner of land at Shell Haven directly abutting the east of the Site.

We note that the boundary and positioning of the proposed works in relation to the Shell UK landholding will result in the proposal requiring the use of land under the ownership of Shell UK Ltd. Please refer to the site plan attached. We object to the use of Shell UK Ltd land for this proposal.

We note that the consultation date on the Notice received under Article 11 and 32 of the Town and Country Planning (Development Management Procedure) (England) Order 2010 is wrong. The landowner notification specifies that any comments on the application are required no later than 21st April 2011. We consider this date to have been calculated in error by the applicant, as the statutory period for consultation is 21 calendar days from the date of the application, rather than 21 working days as stated. On this basis the correct consultation period runs to 13th April 2011. We want to confirm that we will be responding in detail and request some flexibility in light of the circumstances on the timescale.

Shell UK Ltd operates a highly sensitive supply and distribution tank farm for aviation fuel from their landholding. Given the scope of the application and the short time period for

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consultation in this context, Shell UK Ltd has undertaken an initial review of the Application and strongly object for the following reasons:

1. The Health and Safety impact of the dense CO2 pipeline on the Shell UK Ltd land holding.
2. The Health and Safety impact of the 144kv electricity cables on the Shell UK Ltd land holding.
3. The impact of rights of access associated with the wayleaves on the Shell land holding, including the Health and Safety risks to Shell operations as result of gas pipeline maintenance.
4. The impact of the wayleaves on Shell's long term access rights to the New Shell Jetty via the Gate 3 Access Road.

Please note that this letter forms our initial representation. We reserve the right to submit further representations as appropriate, particularly in the light of any further information or documentation submitted in support of the Application. To this end, please keep us fully consulted and I trust you won't mind us telephoning to discuss the Application as this matter progresses. Please contact Guy Bransby (0207 399 5409) or Rob Copley (0207 852 4122) of these offices with any queries.

Yours faithfully,

Jones Lang LaSalle Ltd.

Jones Lang LaSalle Limited

Cc Chris Lambert, for Shell UK Ltd

Enclosures:

1. Drawing LGW-008-177: Park Land Transfer Plan Sheet 4 of 4 detailing DP World land ownership boundary to Shell Haven


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GENERAL NOTES
KEY
SHEET LAYOUT
FOR CONTINUATION SEE LGW-GGG-176
FOR CONTINUATION SEE LGW-GGG-175
FOR INFORMATION (ALC)
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Description
Date
CULLEN GRUMMITT & ROE (UK) Ltd
Chartered Civil Engineers
Consulting Engineers - Harbour, Civil & Structural
Client
DP WORLD
Project
LONDON GATEWAY
PARK LAND TRANSFER PLAN
Designed
Checked
Scale
Drawn
Approved
Date
Size
A1
Drawing Number
LGW-GGG-177
FOR INFORMATION

Essex County Council
Environment, Sustainability and Highways
County Hall
Chelmsford
Essex
CM1 1QH

Specialist Archaeological Advice

Dear Matthew

11/50286/TTGFUL: LAND BETWEEN FORMER SHELL HAVEN (LONDON GATEWAY SITE) AND, ST CLERES GOLF COURSE WEST OF BUTTS LANE

Thank you for consulting the Historic Environment Branch of Essex County Council on the above application.

The Historic Environment is dealt with under section 15 Cultural Heritage of the application. As stated on an the earlier application for the Gateway Energy Centre there is concern regarding the historic environment work undertaken, which is not to the normal standard expected for a project of this nature in such a sensitive area. The present pipeline route bisects an area extensively studied in recent years. Much of this work has been undertaken by the archaeological consultants and contractors for the London Gateway project. A programme of aerial survey in the last two years, undertaken by ECC has identified extensive archaeological cropmarks in the western area of the proposed route.

In the case of this submission it is surprising that there are no supporting documents within the appendices for the Historic Environment. The single archaeological/cultural heritage figure (no 15.1) only provides evidence using spot data information which is unhelpful and does not show the extent or complexity of the Historic Environment assets within the development area.

The submitted report suggests there has been no detailed survey work apart from a desk based search and walkover survey, and even then details of this walk over survey are not provided within the appendices. The desk based survey also does not seem to have used the material stored within the Historic Environment Record at ECC and has been based on only web access to this material

Under 15.2 Key Planning Policies: no mention is made of PPS 5 although it is referred to later on, it should be included within this section.

Overall the historic environment background shows a poor understanding of the history of this area and the potential of the application area. This is disappointing especially due to the extensive amount of information potentially available to the applicant's consultants. Some of the major inaccuracies include:

15.4.5 The gravel terrace is located between the 5 and 10m contour and is one of the most highly sensitive areas for the Historic Environment

15.4.9 This general area is one of the most complex prehistoric landscape in the historic county of Essex. The major excavations at Mucking with occupation from the Neolithic to the medieval period have been ignored.

A major omission for the Roman period is that no mention is made of the salt making industry. It is mentioned in the post medieval period, however, the extensive remains, such as at Stanhope Industrial Area have not been mentioned.

The medieval period is under represented with no mention of the importance of the Great Garlands, the earthworks which are probably medieval in origin and the association with the excavations on the marsh edge by both ECC and OA.

The post medieval/modern period is relatively well presented.

The aerial photographic section of the report is very poor. In the letter this office provided for the scoping opinion (14-12-10) it was recommended that a digital plot of the known cropmarks be created for the proposed application. This has not been undertaken.

15.4.77 Although previous evaluation work has been used to create a picture of the historic environment of the area the consultants have failed to understand the impacts. For the new access road the document emphasised that there was little archaeology found, which is incorrect as both prehistoric and medieval deposits were identified. It also fails to point out that the whole area is proposed for strip map and excavation before development proceeds.

15.5.1 The main impact will be the stripped corridor for the pipe trench. As experienced on the previous corridor, which was 40m wide the tracking of machines once top soil has been removed will destroy or damage most archaeological deposits.

15.5.6 The document indicates that there will only be minor impact on sites of regional and local interest. It is the recommendation of this office that with the level of work undertaken so far it is not possible to make this statement.

15.5.8 The work proposed by the developer in overlaying existing historic environment information to assess the mitigation required, is appropriate, however, this work should have been undertaken as part of the to support this planning application.

15.6 Mitigation measures. The proper identification and evaluation of the extent character and significance of the archaeological remains is needed as part of this ES not as part of the mitigation strategy.

Overall this document is very disappointing and fails to appropriately assess the impact of the proposed development on the historic environment. Prior to any decision being made on this application further work is needed on upgrading the historic environment assessment. A meeting has been held with the applicants and a copy of this letter has been requested by them. The limited information in the application was discussed and this office offered the chance to discuss in detail with the archaeologists representing Intergen the problems.

The Historic Environment Branch recommendation is that no decision is made on this application until the Historic Environment impacts have been appropriately assessed and the Historic Environment section resubmitted.

If you have any questions please do not hesitate to contact me.

Yours sincerely

Richard Havis
Senior Historic Environment Officer

Telephone: 01245 437632
Fax: 01245437213
Email: richard.havis@essex.gov.uk

Alison J Campbell *B.A. Dip.LA .FLI*

Principal Landscape Officer
Thurrock Council
New Road, Grays, Essex
RM17 6SL

01375 65 2927
www.thurrock.gov.uk

RE: To develop an underground gas Pipeline and above ground installation (AGI) and ancillary development

Landscape / Greengrid considerations
AGI Proposal
The proposed site of the AGI plant lies on upper slopes of the escarpment that overlook the Mucking marshes. The ridge line settlement of Stanford le Hope and the artificial landscapes of St Clere's golf course are screened from skyline views from lower elevations to the south. Tree and overgrown hedgerows intermittently line the road and rail transport routes which swing though the area. An active waste landfill site at Mucking has previously blighted the character of the area. Although the artificial landforms of the restoration landscape alters the historic character of view to the estuary, the Thurrock Thameside Nature Park proposal to manage tree lines lakes and rough grassing land will contribute to the character of a tranquil rural coastline. Panoramic views from footpath (PROW41) and the ridgeline which extending south west from Stanford le Hope, are expected to become increasingly valued as the development of London Gateway and DPWorld will visually block view of the river from elevated ridgeline views to the east.

The two over head power lines, running east to south west, are a conspicuous detractor within the relatively small scale landscape features of the immediate surroundings of the proposed AGI site. The artificial green security fenced box of the existing AGI plant at Butts Lane is considered to be a recognisably industrial feature set into a belt of vegetation which extends across the southern extent of St Clere's golf course.

The proposed AGI plant is significantly larger than the existing AGI plant. Locating the proposed AGI plant within the arable fields to the south of the access track is predicted to significantly increase the likely impacts to landscape character and visual amenity. The proposed screening will assist to mask the built features overtime and filter view of the open face of the existing AGI plant. The artificially square block of vegetation extending into the arable field is, however, considered to be incongruous to the small scale rolling slopes.

It is recommended that the vegetation block be extended to form a sweeping lens of vegetation along the access track and farming tack beyond. It is predicted that this would also assist management of the crop by integrating the square intrusion into more efficient farming vehicle movements.

The description of “pailing” security fencing raises concerns. The visual intrusion of security fencing is significantly altered by the detail design and finish colour. The assessment of predicted harm and recommendation above are based on replicating a similar system of security weld-mesh fencing with green finish of the existing AGI plant.

There appears to be up to six posts to support a mixture of CCTV and lighting on the proposed site. The increase of vertical structures and light intrusion into the dark nightscape raises concern. The detail design of these features and specification of finishes can appreciably alter the visual intrusion. The assessment of predicted harm and recommendation above are based on replicating a similar design on CCTV and lighting of the existing AGI plant. The reflective nature of the existing features is apparent and consideration of alternative surface finish of the proposed structures is recommended.

Recommendation:
That an approval of the proposed AGI plant at Butts Lane is subject to further approval of the landscape scheme including the extent, layout and specification of a vegetation buffer and agreement of long term management.

That an approval of the proposed AGI plant at Butts Lane is subject to further approval of detail design and specification of fencing, lighting and CCTV structures.

Reason:
To safeguard the landscape character and visual amenity of the local area.

<u>Pipeline Route selection</u>

It is noted that the environmental assessment did not include consideration of what would appear to be the shortest and most direct pipeline route, which could run parallel to the railway branch-line to Thames Haven. A significant area of land associated with this route has been extensively studied and mitigation proposals well advanced as part of London Gateway logistic park and DPWorld’s deep sea port. It is considered that the technical feasibility and likely environmental impacts should be presented for this route.

The DPWorld and London Gateway Development and the Gateway Energy Centre are commercially and operationally related and as such there is opportunity to achieve mutual agreement of construction phasing and easements.

Recommendation
That consideration of approval of the application required the technical feasibility and environmental impacts of a gas pipeline in proximity and parallel to the railway branch-line to Thames Haven is presented as part of the evidence base for the pipeline route selections.

Reason
To ensure the Environmental Statement is supporting by a robust consideration to options which are likely to achieve significant mitigation by avoidance.

<u>Pipeline and ancillary features proposal</u>

The importance of the open character of the Greenbelt, to retain the historic

character of ridgeline settlement set above costal marshes and the separation of large scale coastal industry, is apparent in long distant panoramic views from the ridgeline. The views from One Tree Hill and country parks of Langdon Hills are prized as the most extensive elevated views in Essex. The extent of pipeline works will be apparent in middle and long distance views across the coast. It is noted in paragraph 18.5.13, that construction impacts are predicted to be reduced by staged works, however the requirement of testing the complete pipeline suggests open cut trenches and access points would remain open until the pipeline is complete and tested. The landscape and visual impact of disturbed ground and temporary structures would therefore not be shortened by staged works along the route.

The potential impact to water quality by the construction of the gas pipeline through the arable farmland and managed coastal grazing area is considered to pose a risk to the historically sensitive landscape character of the area. Landform features and habitat vegetation are considered to be particularly vulnerable to water control measures.

It is noted that the proposed construction of the gas pipeline through the Local Wildlife Areas Stanford Warren Wetland and Stanford Warren Meadow is to be via open cut trenching. It is considered that this method of construction will generate unacceptable harm to the environmental sensitivity of the area.

Recommendation:
That a mitigation and enhancement measures of the proposed development are complimentary to, and form part of, Landscape and Environmental Mitigation Schemes approved in relation to the Gateway Energy Centre and associated development by the applicant.

Reason:
To safeguard the landscape character and visual amenity of the local area.
To ensure the coordination of design, construction and remediation works, minimises harm and maximises benefit to the strategic and local Greengrid.

Recommendation:
That an approval of the proposed underground gas pipeline is subject to applicant's facilitation of approval and subsequent agreements of detail design of construction and remediation works between Thurrock Council and landlords and interested parties of land affected by the proposed development.

Reason:
To safeguard the landscape character and visual amenity of the local area.
To ensure the viability and sustainability of remedial and enhancement works and their long term management, by agreement of interested parties.

Recommendation:
It is recommended that the complete pipeline route between London to Southend Railway Crossing RXL1 and Wharf Road Crossing RDX 2, should constructed via Horizontal Directional Drilling.

Reason:
To safeguard the value and character of Local Wildlife Reserves.

Cumulative Impacts

The description and assessment of likely impacts are of great assistance to consideration of this application. However it is considered that the impacts of an electrical substation and sealing end plant structures, associated with an electrical connection, are not sufficiently accounted for.

It is noted that the assessment of predicated impacts of overhead electrical connections are to be mitigated by association with existing overhead routes. It is considered that in areas where the scale of landscape is reduced by local features, that the additional width, of the over head electrical route is likely to generate significant landscape and visual harm.

The impact of the proliferation and increased clutter of large scale vertical features in the coastal zone, including pylons, sealing end electrical connections, proposed power station stacks and proposed DPWorld cranes, is considered to generate significant harm.

The proposed gas pipeline is predicted to be in close proximity of other associated infrastructure works by the applicant, such as the electrical connection to a proposed substation in East Thurrock. Separation of the construction of these developments, by distance or timing would no doubt be advantages in terms of contract administration; however, such separation is predicted to generate significant environmental harm, by extending the areas disturbed by construction or consecutive reworking or interventions that impact landscape elements over time.

Recommendation:
That the detail design and construction / remediation programme of works for proposed gas pipeline is integrated with associated works of Gateway Energy Centre, by the applicant, such as electrical connection works to a substation.

Reason:
To minimise cumulative impacts of associated major infrastructure projects serving Gateway Energy Centre power station.

Yours sincerely
Alison Campbell

APPENDIX B

UPDATES TO MARCH 2011 ES SECTIONS 2 AND 3

B UPDATES TO MARCH 2011 ES SECTIONS 2 AND 3

Introduction

The changes to ES Section 2 and ES Section 3 due to the release of the new NPSs are shown in:

Appendix B.1 – Updated March 2011 ES Section 2.4

Appendix B.2 – Updated March 2011 ES Sections 3.2 and 3.3

APPENDIX B.1 UPDATED MARCH 2011 ES SECTION 2.4

2. RATIONALE FOR DEVELOPMENT

2.4 National Policy for Energy Infrastructure now covered by the Planning Act 2008

2.4.1 National Policy for energy infrastructure (including NSIPs) covered by the Planning Act 2008 is provided in the Overarching National Policy Statement (NPS) for Energy (EN-1) Version for Approval, and the technology-specific NPSs. Used together, the NPSs form the primary policy basis for decisions made by the IPC (and its successor) on applications for energy infrastructure / NSIPs under the Planning Act 2008.

2.4.2 Although, as discussed in Section 1.5, the gas pipeline and associated AGI do not fall under the remit of the Planning Act 2008, EN-1 states (at Paragraph 1.2.1) that:

"*In England and Wales this NPS is likely to be a material consideration in decision making on applications that fall under the Town and Country Planning Act 1990 (as amended). Whether, and to what extent, this NPS is a material consideration will be judged on a case by case basis*".

Furthermore (at Paragraph 1.2.3) it states:

"*Further information on the relationship between NPSs and the town and country planning system, as well as information on the role of NPSs is set out in paragraphs 13 to 19 of the Annex to the letter to Chief Planning Officers issued by the Department for Communities and Local Government (CLG) on 9 November 2009*". [1]

2.4.3 In the letter to the Chief Planning Officers issued by the CLG, it states (at paragraph 13) that:

"*The new single consent regime for NSIPs will operate alongside the town and country planning regime. Although the two regimes are legally different, there are close interactions between them*".

Furthermore (at paragraph 17) it states:

"*NPSs may specifically set out policies which will need to be taken into account by decision-makers other than the IPC. … LPAs and other decision-makers should therefore take account of those policies when determining applications for consent for below-threshold infrastructure applications made under the town and country planning regime*".

2.4.4 Based on the above, it is therefore considered that the NPSs form a material consideration for the development of the gas pipeline and associated AGI.

2.4.5 Therefore information provided on National Policy for energy infrastructure in EN-1 (and the associated discussion on the *"Need for New Nationally Significant Energy Infrastructure Projects"*) and the technology-specific NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) provide the basis for the rationale for development of the gas pipeline and associated AGI.

2.4.6 EN-1 states (at Paragraph 2.1.2):

"*energy is vital to economic prosperity and social well-being and so it is important to ensure that the UK has secure and affordable energy. Producing the energy the UK requires and getting it to where it is needed necessitates a significant amount of infrastructure, both large and small scale*".

2.4.7 Furthermore, EN-1 states (at Paragraphs 3.1.1 to 3.1.4):

[1] http://www.communities.gov.uk/documents/planningandbuilding/pdf/1376507.pdf

"*The UK needs all types of the energy infrastructure covered by this NPS in order to achieve energy security at the same time as dramatically reducing greenhouse gas emissions.*

It is for industry to propose new energy infrastructure projects within the strategic framework set by Government. The Government does not consider it appropriate for planning policy to set targets for or limits on different technologies.

The IPC should therefore assess all applications for development consent for the types of infrastructure covered by the energy NPSs on the basis that the Government has demonstrated that there is an urgent need for those types of infrastructure and that the scale and urgency of that need is as described for each of them in this Part.

The IPC should give substantial weight to the contribution which projects would make towards satisfying this need when considering applications for development consent under the Planning Act 2008".

2.4.8 It is considered that the above discussion on the National Policy for energy infrastructure is applicable to the development of the gas pipeline and associated AGI. Furthermore, as the gas pipeline and associated AGI form part of wider development of energy infrastructure (i.e. the development of GEC, including all its associated benefits) it is also considered that, in line with EN-1, the need (rationale) for the development of the gas pipeline and associated AGI has been demonstrated and the need for this development is urgent.

APPENDIX B.2 UPDATED MARCH 2011 ES SECTIONS 3.2 AND 3.3

3 PLANNING POLICY CONTEXT

3.3 National Policy

Overarching National Policy Statement for Energy (EN-1)

3.3.36 EN-1 (July 2011) sets out national policy for the energy infrastructure constituents of the NSIPs listed in EN-1, namely onshore generating stations of more than 50 MW (and 100 MW offshore), produced from fossil fuels, wind, biomass, waste and nuclear (in respect of the sites listed in the Nuclear NPS EN6) (EN-1, paragraph 1.4.1). Other forms of energy NSIPs include electricity lines at or above 132 kV, large gas reception, liquefied natural gas (LNG) facilities, underground gas storage and oil/gas pipelines, subject to specified minimum size limitations. Although the Proposed Development is not a NSIP, it is pointed out in EN-1 that in England and Wales, this NPS is likely to be a material consideration in decision making on applications that fall under the TCPA 1990 (as amended) to be judged on a case by case basis (EN-1, 1.2.1, EN-2, 1.2.3, EN-4, 1.2.3, EN-5, 1.2.3). Reference is also made (EN-1, 1. 2. 3) to a letter sent to Chief Planning Officers from DCLG on 9.11.09 explaining the relationship between NPSs and the town and country planning system,

3.3.37 Part 2 EN-1 states that "*energy is vital to economic prosperity and social wellbeing and so it is important to ensure that the UK has secure and affordable energy*" (EN-1, 2.1.2). It considers that in making the transition to a low carbon economy, it is critical that the UK continues to have secure and reliable supplies of electricity and that to manage the risks; the country needs (paragraph 2.2.20):

- sufficient capacity (including a greater proportion of low carbon generation) to meet demand at all times, requiring a safety margin of spare capacity
- reliable associated supply chains (e.g. fuel for power stations) to meet demand as it arises
- a diverse mix of technologies and fuels to avoid reliance on any one technology or fuel
- effective price signals so that market has sufficient incentives to react in a timely way to minimise supply/demand imbalances.

Each of these items is applicable to GEC.

3.3.38 In the medium term, EN-1 considers that there are a number of challenges which must be faced in including replacing existing power plants, and developing infrastructure so as to maintain and improve security and access to competitive supplies , particularly for electricity generation, gas importation and storage (EN-1, 2.2.21) and, while the Government plans to pursue its objectives for renewables, nuclear power and CCS, it is accepted that some fossil fuels will still be needed during the transition to a low carbon economy with provision for carbon capture and storage (CCS) (EN-1, 2.2.23).

3.3.39 Part 3 considers the need for new NSIP projects and Section 3.1 sets out "*the planning policy"* referred to earlier in this ES 2.4.7. With regard to the need for new NSIPs, it is explained that electricity meets a significant proportion of our overall energy needs and that the country's reliance on it is likely to increase (EN-1, 3.3.1). EN-1 discusses, meeting energy security and carbon reduction objectives, replacement of closing electricity generating capacity, the need for more electricity capacity to support an increased supply from renewables, future increases in electricity demand, the urgency of the need for new electricity capacity, alternatives to new large scale electricity generation capacity (reducing demand, more intelligent use of electricity and interconnection of electricity systems) (EN-1 3.3). It is confirmed that

fossil fuelled power stations play a vital role in providing reliable electricity supplies; they can be operated flexibly in response to changes in supply and demand and provide diversity in energy mix; however in making the transition to a low carbon economy, fossil fuel generation must be constructed/operated in line with increasingly demanding climate change goals (EN-1, 3.6.1). Gas fired generation has an important role in the electricity sector, *"providing vital flexibility to support an increasing amount of low-carbon generation and to maintain security of supply"*; consequently it is important that the UK gas market continues to diversity its sources of supply (EN-1, 3.6.2). It is predicted that some of the new generating capacity required to maintain security of supply and to provide flexible back-up for intermittent renewable/wind energy will be provided by fossil fuelled plants. At present, coal typically produces about twice as much carbon dioxide as gas per unit of electricity; new technology offers the prospect of reducing carbon dioxide emissions, where *"whilst retaining many of their existing advantages, they also can be regarded as low carbon energy sources"* (EN-1, 3.6.3).

3.3.40 EN-1, Part 4 sets out general policies in accordance with which applications relating to energy infrastructure, are to be decided that they do not relate only to the need for new energy infrastructure, or to particular physical impacts in the technology specific NPSs (EN-1, 4.1.1). The IPC is required to start with a presumption in favour of granting consent to energy nationally significant infrastructure projects (NSIPs), unless otherwise indicated by specific NPSs or the PA 2008. When weighing adverse impacts against benefits, the IPC should have regard to potential benefits including the contribution to the need for infrastructure, jobs and long term/wider benefits and the relative benefits and dis-benefits identified by the EIA process as well as environmental/social/economic benefits/adverse impacts, taking into account mitigation measures, development plan and other documents in the local development framework (LDF), planning conditions and development consent obligations. The matters to be considered are listed below; these matters have been addressed in the GEC application (and where relevant in the application), namely the provision of an ES, consideration of the requirements of the Conservation of Habitats and Species Regulations 2010; examination of alternatives; importance of good design; consideration of CHP; demonstrating that the project is CCR (enabling the eventual provision of CCS); climate change adaptation; grid connection requirements; pollution control/other environmental regulatory regimes; safety; hazardous substances; health; common law/statutory nuisance and security considerations (EN-1, Part 4).

3.3.41 Of the above, all relevant matters have been addressed in the EIA process and presented in the ES and accompanying documents. In particular, it is advised that the question of whether the project is likely to have a significant effect on European designated sites alone, or in combination with other plans or projects should be considered (EN-1, 4.3). The approach taken in this case at the screening stage has been to follow the approach taken in the Waddenzee1 case namely:

"*45. In the light of the foregoing, the answer to Question 3(a) must be that the first sentence of Art.6(3) of the Habitats Directive must be interpreted as meaning that any plan or project not directly connected with or necessary to the management of the site is to be subject to an appropriate assessment of its implications for the site in view of the site's conservation objectives if it cannot be excluded, on the basis of objective information, that it will have a significant effect on that site, either individually or in combination with other plans or projects."*

3.3.42 There is no general policy requirement to consider alternatives or establish whether a proposed project represents the best option; however, applicants must include in the ES information about the main alternatives they have studied, where relevant, follow legal requirements under the Habitats Directive to consider alternatives and consider

alternatives where required under NPSs (EN-1, 4.4.1/2). Given the level and urgency of need for new infrastructure, whether a policy or legal requirement exists to consider alternatives, the IPC should consider the following principles (EN-1, 4.4.3):

(a) the consideration of alternatives should be carried out in a proportionate manner.

(b) in considering alternatives, the IPC should be guided by whether it is realistic for the alternative to deliver the same infrastructure capacity as the proposed development (including energy security/climate change benefits) in the same timescale

(c) where legislation imposes a quantitative target for particular technologies, or as with nuclear, there are limitations on the number of sites suitable within the relevant timescale, the IPC should have regard, as appropriate, to the possibility that all suitable sites for energy infrastructure of the type proposed may be needed for future proposals.

(d) alternatives not studied in the ES should only be considered to the extent that the IPC thinks they are both important and relevant to its decision.

(e) the IPC should consider an application in accordance with the relevant NPSs.

(e) it should be reasonable for the IPC to conclude that alternative proposals not in accordance with the relevant NPS cannot be important and relevant to its decision.

(f) alternative proposals that are not commercially viable, or where sites would not be physically suitable or alternative proposals are *"vague or inchoate"* may be excluded on the grounds that they are not important/relevant.

(g) where alternatives are put forward by a third party, that party should provide evidence of the site suitability and the applicant should not necessarily be expected to have assessed the site.

The alternatives considered by the GECL in respect of this Proposed Development have been described in the ES (Section 6).

3.3.43 The criteria for good design for energy infrastructure are discussed in EN-1, 4.5 which notes that visual appearance of a building is sometimes considered as the most important factor in good design but that *"The functionality of an object – be it a building or another type of infrastructure – including fitness for purpose and sustainability, is equally important"* (EN-1, 4.5.1). It requires applicants to demonstrate how the design process was conducted and the design evolved; the IPC is directed to *"take into account the ultimate purpose of the infrastructure and bear in mind the operational, safety and security requirements which the design has to satisfy"* (EN-1, 4.5.4). Further advice on what should be expected by way of good design is provided in the technology specific NPSs, where relevant (EN-1, 4.5.6), whereas EN-4, 2.3 refers applicants to EN-1, 4.5, while stating that applicants should demonstrate good design, in particular, where mitigating the impacts relevant to the infrastructure. Grid connection (EN-1, 4.9) is not part of this application, although it is considered in Section 18 (Indirect, Secondary and Cumulative Impacts). It notes that, wherever possible, generating stations and related infrastructure will be in a single application or in separate applications submitted in tandem which have been prepared in an integrated way; where this is not possible, the reasons should be explained and if there are no obvious reasons why the necessary approvals for other elements are likely to be refused, that should not fetter the IPC's subsequent decisions on any related projects.

3.3.44 Planning and pollution control systems are separate but complementary; EN-1 advises that if the criteria identified at 4.10.7 (namely that potential releases can be

adequately regulated, and that cumulative effects would not make the development unacceptable) are satisfied, the IPC should not refuse consent on the basis of pollution impacts, unless it has good reason to believe that any relevant necessary operational pollution control permits or licences or other consents will not subsequently be granted (EN-1, 4.10.8). The IPC is required to consult with the HSE on matters relating to safety (EN-1-4.11) and on hazardous substances consent applications, for which the IPC is the Hazardous Substances Authority (EN-1-4.12). Health effects should be assessed, which may arise from increased traffic, air or water pollution, dust, odour, hazardous waste and substances, noise, exposure to radiation or increases in pests (EN-1, 4.13); finally, common law/statutory nuisance (EN-1, 4.14) and security considerations should be addressed where relevant (EN-1, 4.15).

3.3.45 EN-1, Part 5 sets out generic impacts to be considered, namely air quality and emissions; biodiversity/geological conservation; civil/military aviation/defence interests; coastal change; dust/odour/artificial light/smoke/steam/insect infestation; flood risk; historic environment; landscape/visual impacts; land use including open space, green infrastructure, Green Belt; noise/vibration; socio-economic; traffic/transport impacts; waste management; water quality/resources. These matters have been addressed in the EIA process where relevant, which includes, in the case of the EN-4 gas pipelines, impacts concerning climate change adaptation, consideration of good design, hazardous substances/control of major accident hazards, noise/vibration, biodiversity/landscape/visual, water quality/resources and soil/geology.

3.3.46 Among the generic impacts listed in the previous paragraph are air quality/emissions, biodiversity/geological conservation, flood risk, historic environment landscape/visual and Green Belt. EN-1, 5.2 (Air Quality and Emissions) states that although an ES, when considering emissions to air, will include an assessment of CO_2 emissions, the IPC does not need to assess individual applications in terms of carbon emissions against carbon budgets, nor address CO_2 emissions, or any emissions performance standard that may apply to plant (EN-1, 5.2.2). EN-1, 5.3 (Biodiversity and geological conservation) refers to ODPM Circular 06/2005 and in England to Planning for Biodiversity and Geological Conservation: A Guide to Good Practice March 2006. Applicants should address in the ES any effects on international, national and locally designated sites of ecological or geological conservation importance, on protected species and habitats and on other species identified as being of principal importance for the conservation of biodiversity (EN-1, 5.3.3). EN-1, 5.7 (Flood Risk) requires applications for energy projects of 1 hectare or greater in FZ 1 in England and all proposals for energy projects in FZs 2 and 3 in England to be accompanied by a flood risk assessment (FRA). The section explains the approach for the IPC to adopt, namely a FRA should be proportionate to the risk and appropriate to the scale, nature and location of the project; consider risk arising from the project in addition to risk of flooding to the project; take impacts of climate change into account; undertake the FRA by competent people; consider adverse and beneficial effects of flood risk; consider the vulnerability of those using the site and safe access; consider the different types of flooding, the range of flooding events and the residual risk and demonstrate this is acceptable; also consider the ability of water to soak into the ground, how drainage systems may be affected and if there is a need to be safe and remain operational during a worst case flood event and be supported by appropriate data (EN-1, 5.7.5). The IPC should be satisfied that the application is supported by site specific FRAs as appropriate, the sequential test applied as part of the site selection, a sequential approach applied at the site level to minimise risk, achieve consistency with flood risk management strategies, prioritise the use of SUDS and in flood risk areas be satisfied that the project is appropriately flood resilient (Statement 5.7.9). EN-1, 5.8 (Historic Environment) draws on PPS5 and its Practice Guide. The

applicant's assessment of the historic environment should describe the significance of the heritage assets, however the level of detail should be proportionate to their importance and "*no more than is sufficient to understand the potential impact of the proposal on the significance of the heritage asset*" (EN-1, 5.8.8) and from a decision making perspective, this should reflect the significance of the heritage assets (EN-1, 5.8.14).

3.3.47 EN-1, 5.9 (Landscape and Visual Impact) advises the IPC in its decision making, that landscape effects depend on the existing character of the local landscape, its current quality, how highly it is valued and its capacity to accommodate change; such that the aim of the developer should be to minimise harm to the landscape and provide mitigation where practicable (EN-1, 5.9.8). It notes that, even in nationally designated areas, whereas the conservation of the natural beauty of the landscape and the countryside should be given substantial weight, the IPC may nevertheless recommend approval in exceptional circumstances, where it can be demonstrated that the proposed development is in the public interest (EN-1, 5.9.9/10. With regard to visual impact, the IPC will have to judge whether effects on sensitive receptors outweigh the benefits of the project (EN-1, 5.9.18) and it is recommended that applicants draw attention to examples of existing permitted infrastructure with a similar magnitude of impact on sensitive receptors (EN-1, 5.9.19). On mitigation, attention is drawn to means of minimising landscape and visual effects through appropriate siting of infrastructure within the site, design including colours and materials and landscaping, as well as the design of buildings (EN-1, 5.9.21.23).

3.3.48 EN-1, 5.10 (Land use including open space, green infrastructure and Green Belt) requires that. Applicants should seek to minimise impacts on the best and most versatile agriculture land, preferably using land in areas of poorer quality, except where this would be inconsistent with other sustainability considerations; impacts on soil should be minimised; when developing previously used land, the risk posed by land contamination should be assessed (EN-1, 5.10.8). It is noted that "*The fundamental aim of Green Belt is to prevent urban sprawl by keeping land permanently open; the most important attribute of Green Belts is their openness"* and it suggests that reference is made to PPG2 (EN-1, 5.10.4). There is advice on IPC decision making on development in Green Belt, in which EN-1, 5.10.17 states as follows. *"When located in the Green Belt, energy infrastructure projects are likely to comprise "inappropriate development. Inappropriate development is, by definition, harmful to the Green Belt and the general planning policy presumption against it applies with equal force in relation to major energy infrastructure projects. The IPC will need to assess whether there are very special circumstances to justify inappropriate development. Very special circumstances will not exist unless the harm by reason of inappropriateness and any other harm is outweighed by other considerations. In view of the presumption against inappropriate development, the IPC will attach substantial weight to the harm to the Green Belt when considering any application for such development while taking account, in relation to renewable and linear infrastructure, of the extent to which its physical characteristics are such that it has limited or no impact on the fundamental purposes of Green Belt designation"*.

National Policy Statement for Fossil Fuel Electricity Generating Infrastructure (EN-2)

3.3.49 EN-2, Part 1 links this NPS, with EN-1, as providing the primary basis for decisions on applications for NSIPs and advises that applications should be consistent with instructions and guidance in, EN-1 and any other relevant NPSs. On the matter of future planning reform, it is noted that the enactment and entry into force of the Localism Bill relating to the PA 2008 would abolish the IPC and its functions taken over by a new MIPU, whereupon the Secretary of State for Energy and Climate Change will be the decision maker (EN-2, 1.4). EN-2 covers electricity generating infrastructure over 50 MW, namely coal fired, gas fired, integrated coal gasification

combined cycle and oil-fired plant (EN-2, 1.8.1) and is mentioned here only to the extent that the Proposed Development is to supply gas to the proposed GEC which is itself within the scope of EN-2. Part 2 notes that the policies set out in this NPS are additional to those on generic impacts in EN-1; it concludes that there is a significant need for new major energy infrastructure and that, in the light of this, the need for the infrastructure covered by EN-2 has been demonstrated (EN-2 2.1.2). It refers to the factors influencing site selection by developers as land use, transport infrastructure, water resources and grid connection (EN-2, 2.2). On the matter of Government policy criteria for fossil fuel generating stations, the following must be met before consent can be given, namely CHP, CCR and CCS (for coal fired generating stations), also climate change adaptation and consideration of "*good design*" (EN-2, 2.3). Reference is also made to impacts of fossil fuel generating stations in respect of emissions to air, landscape and visual impact, noise / vibration, dust (applicable to coal), residue management (applicable to coal) and water quality resources (EN-2, 2.4.1). All relevant considerations in respect of the proposed GEC have been addressed in the EIA process.

National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4)

3.3.50 It has been stated earlier that the Proposed Development is not a NSIP, however there is advice in EN-4, 1.2.3 that NPSs are likely to be helpful to LPAs as a material consideration in decision making on relevant applications that fall within the TCPA 1990 (as amended); to what extent an NPS is material will be judged on a case by case basis.

3.3.51 Part 2 (Assessment and Technology-Specific Information) notes that the policies set out in EN-4 are additional to those on generic impacts in EN-1, which sets out the Government's conclusion that there is a significant need for new major energy infrastructure generally and that, in the light of this, the need for gas supply infrastructure and oil and gas pipelines is such that the *"IPC should act on the basis that the need for the infrastructure covered by this NPS has been demonstrated"* (EN-4, 2.1.2). On the matter of site selection, it is stated that *"it is for energy companies to decide what applications to bring forward and the Government does not seek to direct applicants to particular sites for gas supply infrastructure and gas and oil pipelines"* (EN-4, 2.1.3). Part 2 requires that applicants should also take into account climate change adaptation, consideration of good design, hazardous substances and control of major accident hazards (COMAH) (EN-4, 2.2-5).

3.3.52 EN-4, refers to gas and oil pipeline networks extending between storage and distribution and providing an important transport mechanism for natural gas, petrol, gas oil, heating oil, diesel and aviation fuel (EN-4, 2.19.1). As already established, the advice given in EN-4 is capable of being relevant to this Application. EN-4, 2.19.4-6 refers first to pipeline safety in which the principal legislation (Pipelines Safety Regulations 1996) requires that pipelines are designed, constructed and operated so that the risks are as low as is reasonably practicable, which Regulations are enforced by the HSE, also discussed in ES 17.0. Advice is given that, when designing the route of new pipelines, applicants should research relevant constraints, including the proximity of existing and planned housing, schools, hospitals, railway crossings, major road crossings, below surface usage, proximity to environmentally sensitive areas, main river and water crossings and proposals for mitigation (EN-4, 2.19.7-9). When choosing a pipeline route, applicants should seek to avoid or minimize adverse effects from usage below the surface and, where that is not practicable, demonstrate in the ES that mitigating measures will be put in place to avoid adverse effects both on/below ground works and on the pipeline. Mitigation may include protection or diversion of underground services, horizontal directional drilling and rerouting (EN-4, 2.19.10). These matters are addressed in the ES

Sections 5 and 6.

3.3.53 EN-4, 2.20 (Noise and Vibration) requires that all noise and vibration sensitive receptors likely to be affected will need to be identified taking into account pre-construction, construction (including HGV traffic) commissioning and operation including above ground plant (E-4, 2.20.1-4), for which there should be an assessment of noise and vibration effects and decision making in accordance with EN-1, 5.11, with measures for mitigation (E4, 2.20.7), which is addressed in ES 10.0.

3.3.54 EN-4, 2.21 (Biodiversity, Landscape and Visual) refers to EN-1, 4.3 and 5.9 as providing the general principles to be applied to an assessment of biodiversity, landscape and visual impacts. It notes that long term impacts of pipelines upon landscape, are likely to be limited once buried and operational, while taking into account limitations on the ability to plant deep rooted vegetation over/adjacent to the pipeline, also structures and indication points necessary to identify the pipeline route and provide service access (EN-1, 2.21.2). Mitigation measures emphasised include reducing working widths and the use of horizontal directional drilling to avoid impacts on protected trees/hedgerows (EN-4, 2.21.6), addressed in the ES 6.0.

3.3.55 EN-4, 2.22 (Water Quality and Resources) refers to EN-1, 5.15 on setting out the generic policy on the protection of the water environment during construction, operation and decommissioning and EN-1, 4.10 on pollution control, requiring an assessment of the effects that will satisfy the IPC after consultation with the EA. Mitigation measures to protect the water environment my include techniques for crossing rivers and managing surface water and other measures including sustainable drainage systems.

3.3.56 EN-4, 2.23.1 (Soil and Geology) refers to the challenges of understanding soil types and underlying strata. Where a pipeline is to go under a designated area of geological or geomorphological interest, alternatives should be considered which either by pass the designated area or reduce the length to the minimum possible; consultation should also be undertaken at an early stage of development (EN-4, 2.23.3-4). From a consenting perspective, the two key determinants of suitability are whether the route is suitable and adverse impacts mitigated and that the route does not adversely affect the integrity of the pipeline (EN-4, 2.23.5). Mitigation should minimise effects on soil and geology, to ensure that residual impacts are minor and should include appropriate treatment of soil, with appropriate soil storage and reinstatement consistent with the Code of Practice for the Sustainable Management of Soils on Construction Sites (EN-4, 2.23.7/8).

National Policy Statement for Electricity Networks Infrastructure (EN-5)

3.3.57 *EN-5* advises that the network "*will need to be able to support a more complex system of supply and demand than currently and cope with generation occurring in more diverse locations*" (EN-5, 1.1.1). This NPS relates to above ground electricity lines of 132 kV and above and other infrastructure for electricity networks that is associated with an NSIP. Part 2 is concerned with impacts and other matters that are specific to electricity networks infrastructure; it restates the fact that, in the light of the advice in EN-1, the IPC should act on the basis that the need for infrastructure covered in this NPS has been demonstrated (EN-5, 2.1.2). It is recognised that the general location of electricity network projects is often determined by the location, or anticipated location, of a generating station and the existing network infrastructure, taking electricity to centres of use and that it will not necessarily be the case that the connection between the beginning and end points will be via the most direct route (EN-5, 2.2.2). EN5 2.2.6 draws attention to the duty imposed on transmission and distribution licence holders by Schedule 9 to the Electricity Act 1989. Paragraph 1(1) of Schedule 9 states:

"(1) In formulating any relevant proposals, a licence holder or a person authorised

by exemption to [generate, [distribute, supply or participate in the transmission of] electricity] —

(a) shall have regard to the desirability of preserving natural beauty, of conserving flora, fauna and geological or physiographical features of special interest and of protecting sites, buildings and objects of architectural, historic or archaeological interest; and

(b) shall do what he reasonably can to mitigate any effect which the proposals would have on the natural beauty of the countryside or on any such flora, fauna, features, sites, buildings or objects."

3.3.58 This NPS provides advice on climate change adaptation, consideration of good design, impacts of electricity networks associated with biodiversity and geological conservation, landscape and visual effects, noise / vibration, electric and magnetic fields (EN-5, 2.4-2.10). On the matter of landscape and visual impact, EN-5 advises that guidelines for the routing of new overhead lines were originally set out in the Holford Rules (subsequently updated) which should be borne in mind by the IPC when considering applications for overhead electric lines.

APPENDIX C

UPDATE TO MARCH 2011 ES SECTION 6

C UPDATE TO MARCH 2011 ES SECTION 6

Introduction

The Further Information, in respect of the March 2011 ES Section 6 is provided in:

Appendix C.1 – Updated March 2011 ES Section 6

Appendix C.2 – Likely Significant Environmental Impacts of Typical Crossings Techniques

APPENDIX C.1 UPDATE TO MARCH 2011 ES SECTION 6

6 CONSTRUCTION METHODS AND OPERATION

6.1 Introduction

6.1.1 This Section provides information on the design, construction, commissioning. operation and decommissioning of the underground gas pipeline and associated AGI.

6.1.2 The majority of environmental impacts arising from the development of gas pipelines and their associated AGIs occur during construction. Accordingly, this Section describes the standard methods which are likely to be used in full or in part during construction of the proposed underground gas pipeline and associated AGI. These construction methods represent proven methods that have been developed over many years from experience on similar projects.

6.1.3 Information on the operation and maintenance of the gas pipeline and associated AGI is also presented, along with a brief summary of decommissioning requirements.

6.2 The Above Ground Installation

6.2.1 The proposed Butts Lane AGI will be an un-manned facility. It will be constructed adjacent to the existing CECL Gas Pipeline AGI, situated west of Mucking and to the south of Stanford-le-Hope.

6.2.2 The application for planning permission to which this ES relates is for the overall Butts Lane AGI. The Butts Lane AGI would comprise two separate AGIs, one to be owned and operated by National Grid and the other to be owned and operated by GECL. The two AGIs would be located adjacent to each other, but would be separated by a fence.

6.2.3 The overall Butts Lane AGI facility will comprise the following:

- National Grid Infrastructure
    - National Grid MOF connection;
    - National Grid instrument kiosk;
    - National Grid emergency shutdown device (a key safety feature);
    - National Grid instrumentation;
    - Isolation joint to electrically isolate the GEC gas pipework from the National Grid pipework; and
    - Lighting and CCTV
- GECL Infrastructure
    - PIG launcher (which allows an intelligent pig to run through the gas pipeline to conduct online inspection);
    - Standby generator (to ensure the AGI can work during the likes of blackouts);
    - Gas Vents;
    - GEC emergency shutdown device
    - GEC instrument kiosk
    - Above ground pipework;
    - Fencing for security purposes;

- Security Lighting and CCTV;
- Landscaping and Biodiversity (to be undertaken in consultation with TTGDC) to ensure the AGI blends in; and
- An appropriate contribution to Greengrid.

6.2.4 The proposed layout and elevation of the Butts Lane AGI are shown in Figure 5.2a and 5.2b respectively.

6.2.5 The Butts Lane AGI will likely be surrounded by a steel palisade security fence approximately 2.7 m high with two double-gated entrances (one for the NG AGI and one for the GEC AGI). The equipment within the AGI, with the exception of lighting columns discussed below, will be lower than 2.7 m. There will be emergency personnel exit gates for both AGIs.

6.2.6 A length of buried pipe approximately 2 m long within the NG AGI will connect the NTaS Number 5 Feeder pipeline to the proposed NG AGI. From the NG AGI, a short length of pipe will be routed to the GEC AGI. There will be an isolation joint installed to electrically isolate the NG pipework from the GEC pipework. Once this short length of pipe is within the confines of the GEC AGI, it will rise above ground, from where it is described as “piping”. The materials or “fittings” welded into the piping will include: isolation joints; large ball line valves; pig launcher; ESD; small valves; and field instruments to monitor gas flow, temperature and pressure. The isolation joint shall isolate the piping from the GEC gas pipeline cathodic protection system that will provide the buried gas pipeline with an anti-corrosion impressed current cathodic protection system. All above ground piping will be painted with a high quality paint system.

6.2.7 There will be a separate Glass Reinforced Plastic (GRP) instrument control kiosk within each AGI into which ducted cabling from the field instruments will converge into a Remote Terminal Unit (RTU). A communication system, via a British Telecom (BT) / similar link, will send monitoring signals back to the NG and GEC control centres. Back up power may be provided from a bank of batteries connected to an Uninterruptible Power Supply (UPS) unit to cover for a sudden loss of mains power. A stand-by diesel generator shall also be provided for longer periods of supply failure. Mains power will be supplied by the local electricity utility into a meter cabinet and BT / similar will install a telephone / datalink cable. There is already an existing electricity supply and BT / similar phone link to the existing AGI which could be utilised.

6.2.8 There is no requirement for mains drainage piping. Run-off surface water will flow off the roads onto the stone chippings and / or soak away trenches. The civils works will include a concrete / tarmacadam road into the off-take and several concrete bases to support the pipe fittings and pigging facilities, as well as paved footpaths.

6.2.9 The remainder of the AGI site will be covered in a layer of terram and chippings spread over it.

6.2.10 Three 4.5 m high lighting columns (one for the NG AGI and two for the GECL AGI) will be erected to provide illumination should maintenance works be necessary in hours of darkness. These will also provide support for the CCTV cameras.

6.2.11 A car parking area will be installed outside the gated entrance.

6.2.12 Landscaping will be planted in order to screen the AGI. This will be agreed with TTGDC, and will aim to provide biodiversity enhancement and supplement the landscaping already present at the existing AGI site. An indication of the area provided for landscaping can be seen in Figure 5.2a, and further discussion is provided in Section 11.

6.2.13 Inserts 6.1 to 6.4 are photographs inside the existing CECL AGI. These indicate the proposed scale of development. It should be noted that the existing (mesh type) security fence at the CECL AGI is also 2.7 m high, with the majority of the equipment shown at a lower height than the fence.

INSERT 6.1 – INSIDE THE NORTH WEST CORNER OF AGI

The Insert above shows the PIG launcher (which forms the majority of the CECL infrastructure) and the CECL instrument kiosk. The equipment sits well below the 2.7 m security fence with the exception of the lighting column.

INSERT 6.2 – INSIDE THE NORTH EAST CORNER OF AGI

The Insert above shows the PIG launcher (which forms the majority of the CECL infrastructure), the National Grid instrument kiosk and the CECL instrument kiosk. The equipment sits well below the 2.7 m security fence with the exception of the lighting column.

INSERT 6.3 – INSTRUMENT KIOSKS

The Insert above shows the National Grid instrument kiosk (right) and the CECL instrument kiosk (left). The double gated security entrance can be seen behind.

INSERT 6.4 – NATIONAL GRID EQUIPMENT

The Insert above shows the National Grid infrastructure and Emergency Shutdown Device.

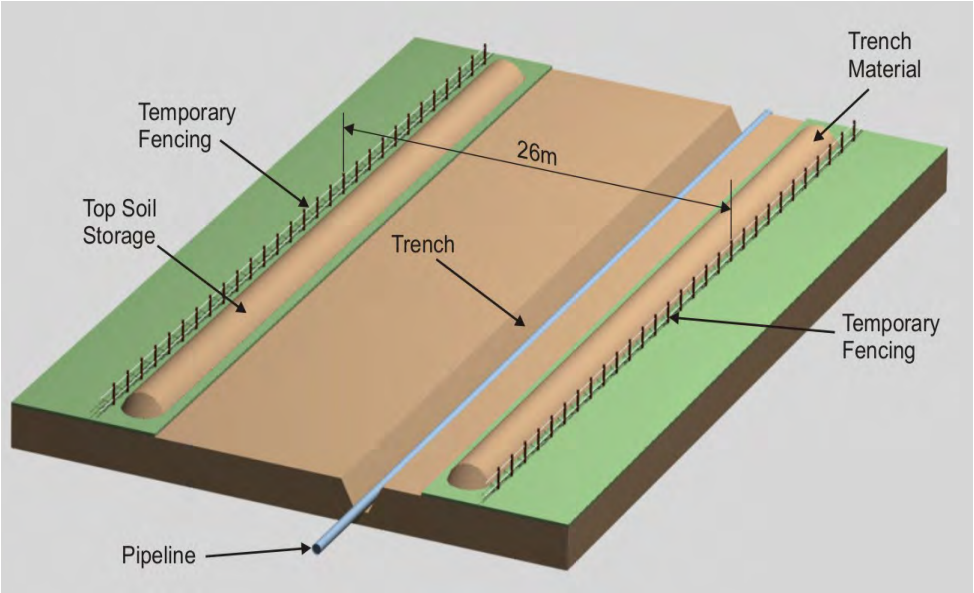
6.3 Gas Pipeline Construction

6.3.1 Construction of an underground gas pipeline is by a pipeline "spread". This is defined as the unit of manpower, plant and equipment necessary to construct a pipeline, from surveying the route through to reinstatement of the land. All construction activities will be undertaken within a temporarily fenced-off strip of land, which is referred to as the "working width". The working width will typically be 26 to 30 m wide, with the pipe offset from the centre line to allow for construction access. Pipeline construction practices will follow those used by National Grid for the construction of their cross-country pipelines. Access to the working width will be at defined points to be agreed by the Local Planning Authority and landowners / occupiers (including existing pipelines owners). Points of access will be carefully controlled and signposted.

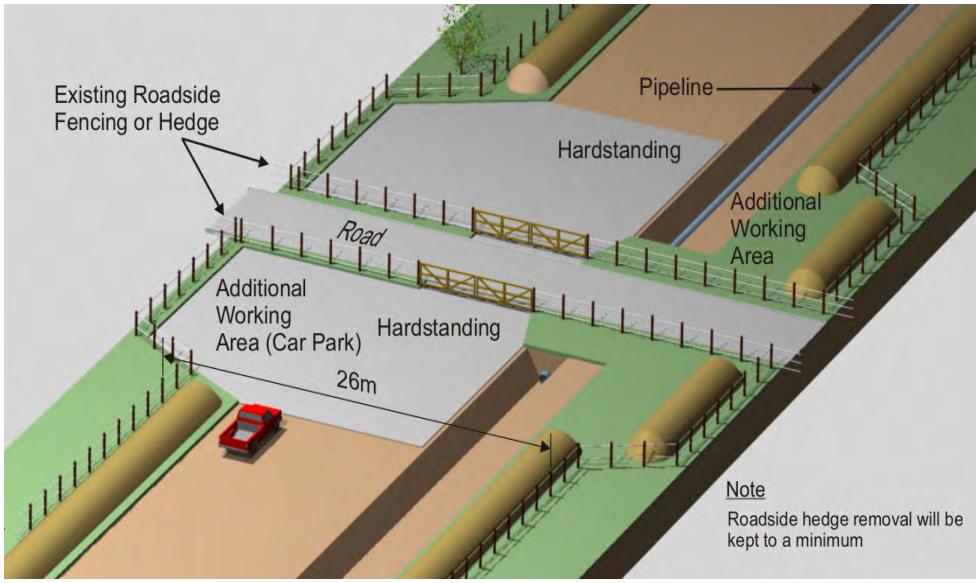
6.3.2 Typical working width layouts are shown in Inserts 6.5 and 6.6.

6.3.3 The working width may be increased in size adjacent to road and other crossings to provide additional working areas and storage for materials or plant. Conversely, the working width may be decreased in size in areas of environmental sensitivity or in close proximity to existing services / utilities (including pipelines).

INSERT 6.5 – ILLUSTRATIVE WORKING WIDTH LAYOUT – MAINLINE



INSERT 6.6 – ILLUSTRATIVE WORKING WIDTH LAYOUT – CROSSINGS



Pre-Construction Activities

6.3.4 It should be noted at this point that the detailed design of the gas pipeline route can only be completed once the design and route of the electrical connection from GEC to the selected National Grid substation has been confirmed. Currently this design and route information is not available, and as such the full detail of the route for the gas pipeline cannot be firmly established.

6.3.5 The design and route of the electrical connection is needed for the detailed design of the route for the gas pipeline as HV cables can induce voltages on the gas pipeline. Therefore, wherever possible, any separation between the two connections would need to be maximised to reduce the level of interference to a defined limit. As such, the detailed design of the gas pipeline route has to be undertaken in conjunction with the detailed design of the electrical connection route.

6.3.6 Of particular relevance is that the route of the gas pipeline north of the A1014 (The Manorway) is close to existing buried pipelines / services / utilities and overhead power cables. Whilst navigating the existing buried pipelines / services / utilities, the proposed gas pipeline route will also need to avoid existing overhead pylons and maintain a minimum separation of at least 15 m. The route of the electrical connection will be a factor to be taken into account. As such, if sufficient separation between the proposed gas pipeline and existing pylons / proposed electrical connection cannot be achieved then it would be necessary to change the gas pipeline route to ensure both its integrity and compliance with code requirements.

6.3.7 In undertaking this work, mathematical modelling will be required to determine the level of induced voltage on the gas pipeline from the existing pylons and proposed electrical connection. The mathematical modelling will confirm that the levels of induced voltage are within acceptable limits. However, this information is not available at this stage. Therefore, the precise crossing point of some third party pipelines / services / utilities cannot be confirmed at this time, and as such the precise construction method to be employed also cannot be confirmed at this time. These details will therefore be confirmed during the detailed design.

6.3.8 Accordingly, Section 6.4 provides information on proposed crossing techniques for third party pipelines / services / utilities. In all cases the selected crossing techniques will aim to minimise both the risk of damage and level of any risk to any third party pipeline / service / utility.

6.3.9 Following the establishment of the gas pipeline route, and the required working width, the normal sequence of events during gas pipeline construction follow those described in this sub-section.

6.3.10 It should be noted that the normal sequence of events described will only be carried out once agreement has been obtained for land owner access and specific land owner restrictions and procedures have been confirmed. The restrictions are expected to cover environmental, archaeological and ecological investigations and the procedures are expected to consist of safe working procedures to be adopted in the vicinity of third party pipeline / service / utility wayleaves.

Fencing

6.3.11 After surveying and pegging the gas pipeline route, the first activity is to erect temporary fences along the boundaries of the working width before any of the principal construction activities begin.

6.3.12 In most areas, the fencing will usually comprise strands of plain or barbed wire and / or square mesh netting, as considered appropriate. Gates and stiles are incorporated into the fencing wherever access must be maintained, such as for public paths, farm

tracks or for livestock movements. In very remote locations, fencing in fields will usually consist of rope supported by wooden posts.

6.3.13 Fencing and access requirements will have been agreed in advance with the landowners / occupiers.

6.3.14 Overhead power lines would be identified and barriers erected to restrict the maximum height of vehicles that may traverse underneath, in accordance with the requirements of the Health and Safety Executive (HSE) given in GS 6: 'Avoidance of Danger from Overhead Electric Power Lines'.

6.3.15 The location of the existing CECL Power Station gas pipeline and other pipelines will be identified and fenced off to ensure that crossings of pipelines by construction plant can only take place at agreed points to mitigate the risk of damage.

Land Drainage Works

6.3.16 Pre-construction drainage will be installed wherever appropriate to help prevent water logging of the working width, and reduce future construction drainage problems.

6.3.17 Particular emphasis is placed on ensuring that existing agricultural land drainage systems crossed by the gas pipeline are maintained and reinstated. At the detailed design stage, land drainage in each field will be carefully inspected and a record prepared.

6.3.18 In discussion with landowners / occupiers, a pre-construction scheme will be developed for those areas where such a scheme is deemed necessary. This may entail the installation of new header drains to intercept the existing land drainage which will be cut by the gas pipeline trench. This serves to maintain the existing drainage system during the construction period whilst minimising the possibility of surface water entering the working area.

6.3.19 In addition, any required land drainage activities within third party pipeline / service / utility wayleaves will only be conducted in accordance with the safe working procedures, which will be agreed in advance of the works.

6.3.20 During construction, all drains encountered during trench digging operations would be identified and recorded. An appropriate method of permanent reinstatement will be devised and agreed with the landowner / occupier. Where the gas pipeline passes under an existing land drain, the usual method of reinstatement is to install a replacement section of drain with a permanent, rigid support carrying it over the filled-in pipe trench. Where necessary, new lateral and header drains would be laid to new outfalls to replace drains rendered inoperative by the gas pipeline.

Topsoil Stripping

6.3.21 Topsoil would be stripped from within the working width and stored to one side to prevent it being mixed with subsoil or being damaged by over-compaction.

6.3.22 Some hedgerows may need to be removed to allow continuous access along the working width. Since hedgerows which have been removed have to be replaced, only the minimum width required for construction is removed. Established trees would be avoided where possible, with both hedging and trees remaining within the working width protected with fencing material where appropriate. Any stone dykes will be dismantled and the stone safely stored for later reinstatement.

6.3.23 In areas of significant environmental sensitivity or very poor soil conditions, topsoil stripping may be omitted in favour of temporary roadways. These roadways will be constructed of a geotextile material and / or hardcore which will be laid over the ground. The topsoil strip and excavation will be limited to the width of the pipe trench alone. In other instances where the topsoil is particularly shallow, the layer of topsoil and the layer of subsoil immediately below it may be stripped and stored separately.

6.3.24 During topsoil stripping, an archaeological watching brief will be present on site to oversee any excavation works.

Pipe-stringing

6.3.25 The gas pipeline is constructed from pre-coated lengths of steel pipe, anywhere between 12 to18 m long. The pipes are initially delivered to a pipe storage yard. The pipe storage yard location(s) will be agreed at a future date and will be located along the underground gas pipeline and associated AGI application corridor and / or potentially within the GEC site. Once required, the pipes would be transported to the working width and laid on wooden sleepers (skids) or cradles along a line parallel to the proposed trench.

6.3.26 Insert 6.7 shows pipes strung out on wooden skids. Gaps would be left where access across the working width is required. Bends would be installed at changes of direction, factory-made where there are sharp changes of direction ('hot bends') or field bends where the changes are less severe ('cold bends').

INSERT 6.7 – PIPES STRUNG OUT ON WOODEN SKIDS

Welding and Joint Coating

6.3.27 The pipes would be welded together to form a continuous steel tube, where each weld is subjected to automatic ultrasonic testing (AUT) inspection. Any faults detected would be repaired or cut out and replaced and then re-inspected.

6.3.28 Radiographic inspection of a limited number of welds may be required at tie ins or similar locations where it is not possible to use the AUT inspection technique.

6.3.29 The pipes arrive on site with a protective coating already applied except at their ends. After welding and inspection, the bare metal at the joints would be cleaned and a coating applied to make the pipeline coating continuous along its entire length.

6.3.30 The gas pipeline coating would then be tested along the whole of its length to detect any damage or other defects. Any weld defects would then be repaired and the gas pipeline coating defects identified will be repaired. All defect repairs will then be re-tested.

Trenching and Laying

6.3.31 A trench will be excavated to a depth that will allow the gas pipeline to be buried with a minimum cover of 1.2 m. The subsoil from the pipe trench excavation will be separated from the topsoil. At road, water and rail crossings, special sections and some other crossings, the depth of cover may be increased. There will be an obligation on the part of the construction contractor to obtain consents from statutory authorities and statutory undertakers prior to crossing these features.

6.3.32 At times it may be necessary to dewater the open trench. Prior to such an activity commencing, schemes will be developed on an area by area basis in consultation with the affected landowners / occupiers.

6.3.33 During pipe laying, side boom tractors or equivalent plant are used to lower the gas pipeline into the trench, taking care to avoid damage to the pipe coating. This is shown in Insert 6.8.

INSERT 6.8 – LOWERING PIPE INTO A PREPARED TRENCH

6.3.34 By utilising standard factory applied pipeline coatings such as 3 layer polyethylene (3LPE) or Fusion Bonded Epoxy (FBE) the pipe will generally have protection from stones and flints. However where field coatings have been applied or aggressive ground conditions have been identified, a bed of sand may be used to provide additional padding and protection to the gas pipeline and applied field coating system.

6.3.35 The trench will then be backfilled with the excavated subsoil. The subsoil is carefully compacted around and over the pipe up to the top of the trench.

6.3.36 ***Cleaning, Gauging, Testing***

6.3.37 The gas pipeline will be cleaned internally using a "pig" which will be driven through the pipe by water or compressed air. A “gauging pig” is then driven through to check the internal diameter of the gas pipeline so as to enable irregularities to be detected and, if necessary, rectified. In addition, a “calliper pig” will be employed to confirm the pipe geometry, and deem that the pipe dimensions are suitable to accommodate an “intelligent pig”.

6.3.38 The gas pipeline will be hydrostatically tested by closing off the ends, filling it with water and increasing the pressure to a pre-determined level higher than the pressure it is designed to operate at. Water used for this purpose may be drawn from a suitable local watercourse and will subsequently be discharged in accordance with approved method statements and EA requirements.

6.3.39 On completion of pressure testing the gas pipeline will be dried with a combination of “drying pigs” and clean compressed air to the required dew point. The gas pipeline will then be purged with nitrogen (N_2) prior to being commissioned with natural gas.

Permanent Reinstatement

6.3.40 Reinstatement, including replacement of the stored topsoil and reseeding of pastureland, will be carried out within the same year as construction, unless prevented by adverse weather. As agreed with the landowners / occupiers,

reinstatement may include deep cultivation or ripping of the subsoil if it has been significantly compacted and spreading of the stored topsoil.

6.3.41 Typical land reinstatement is shown in Insert 6.9.

INSERT 6.9 – TYPICAL LAND REINSTATEMENT

6.3.42 Banks, walls and fences will be reinstated and hedges replanted between protective fences. Permanent gas pipeline aerial and ground marker posts and cathodic protection test posts will be installed at agreed locations, generally at field/road boundaries, so as to minimise interference with normal agricultural operations.

6.3.43 Finally, the temporary fencing along the working width will be removed, unless the landowner / occupier prefer it to be left in place until the re-seeded pastureland is fully established, which would typically take one growing season. In ecologically sensitive areas reinstatement may be modified to suit the local prevailing conditions.

6.4 Typical Crossing Techniques

6.4.1 In addition to the main spread, special teams will be set up by the appointed Construction Contractor to undertake any works associated with road / rail / water crossings and other crossings which require some variation from the standard methods. These works are defined as “special crossings”.

6.4.2 For example, in sections of particular environmental sensitivity, modifications are made to the standard spread technique and / or to the timing of construction with a view to minimising environmental impacts.

6.4.3 Table 5.1 has provided a list of the crossing techniques likely to be required for the proposed gas pipeline.

6.4.4 Therefore, the rate at which the pipeline spread advances is determined by the nature of the terrain, the frequency of special crossings and other factors.

6.4.5 At special crossings the standard construction procedure is adapted to suit each site's specific needs, and to satisfy the requirements of the relevant authorities and landowners / occupiers.

6.4.6 In addition to adapted construction methods, further measures may be taken to reduce the risk of third party damage to the gas pipeline. These may include:

increased depth of cover; thicker walled pipe; installation of pipeline warning tape; concrete slab placement above the gas pipeline; and, screw anchors or concrete weight coating applied to the pipe.

Open Cut – Private Roads / Tracks / Ditches

6.4.7 For private roads / tracks / ditches the open cut construction technique may be used whereby a trench is dug directly across the private road / track. Once dug, a short section of pipe is installed and the trench backfilled with the graded excavated material. The surface of the private road / track / ditch will then be reinstated with appropriate material.

6.4.8 In the case of ditches, the pipe will be installed at the depth required by the pipeline design standard IGE/TD/1, and protective concrete slabs will be installed if the crossing technique permits this.

Auger Boring (Typical Trenchless Method)

6.4.9 The auger boring method is shown in Insert 6.10

6.4.10 This method is likely to be used for all 'B' and 'C' class roads where the disturbance caused by a gas pipeline crossing by open cut may be regarded as unacceptable. Auger boring may also be used at some watercourse and third party pipeline crossings.

INSERT 6.10 – AUGER BORING AT A ROAD CROSSING

6.4.11 Auger boring is a relatively simple trenchless technique that limits surface disturbance. Two pits are dug, one at either end of the crossing section. The sides of the pits will be either graded with a gentle slope, or, if there is limited space, interlocking sheets and frames may be installed to provide sufficient support to the pit and prevent collapse.

6.4.12 The drilling pit is dug wide enough and long enough to take a set of rails on which the auger equipment will run and also accommodate a full length of pipe. It is necessary to increase the working width at crossings in order to store the extra spoil and accommodate the extra plant, vehicles, welfare facilities and other equipment required for this activity.

6.4.13 It should be noted that not all ground conditions are suitable for auger boring, notably where there are large boulders present.

6.4.14 During drilling, a short length of sacrificial pipe is normally placed between the drilling-head and the live pipe and thrust through the ground until it reaches the reception pit on the far side of the crossing. An auger tool called a helix removes the spoil from within the pipe and returns it to the drilling pit.

6.4.15 After the live pipe is positioned through the drilled hole it will eventually be tied into the rest of the gas pipeline.

Tunnelling (Pipe-Jacking and Micro-Tunnelling)

6.4.16 Where auger boring is impractical, then tunnelling may be used as an alternative. Tunnelling can be by manned-entry (pipe-jacking) or un-manned entry (micro-tunnelling).

Pipe-Jacked Crossing

6.4.17 This trenchless crossing method involves digging pits on either side of the crossing to a pre-determined depth. The pits are shored up using interlocking sheet-piles and hydraulic frames.

6.4.18 A diesel driven jacking device and running rails are laid in the base of the reception pit and a metal protection shield installed at the rock-face. Jack hammers are used to jack away at the rock-face with the spoil deposited into a wagon, which is lifted out of the pit. As progress is made, concrete rings are driven forward into the hole using hydraulic jacks. Alignment is maintained by laser beam.

6.4.19 Once the hole is complete and the equipment removed, welded pipe on spacers is threaded through the concrete rings, the ends of the tunnel are bricked up and the annulus filled with an alkaline grout.

6.4.20 This is shown in Insert 6.11.

INSERT 6.11 – PIPE JACKING (MANNED –ENTRY)

Micro-Tunnelling

6.4.21 Micro-tunnelling is similar to pipe-jacking, but a man is replaced by a machine. This method is especially useful for tunnelling beneath crossings where a manned entry is not possible on health and safety grounds.

6.4.22 The micro-tunnelling method is shown in Insert 6.12.

INSERT 6.12 – MICRO-TUNNELLING EQUIPMENT

Horizontal Directional Drilling

6.4.23 Horizontal Directional Drilling (HDD) is normally used for long crossings at dual carriageways, wide rivers and railways, or at particularly sensitive crossings where alternative trenchless techniques prove to be unfeasible. It can also be used to drill under woodlands. HDD uses a steerable cutting head to bore down under an obstacle and come up on the other side.

6.4.24 Detailed site investigation is essential in determining this method's feasibility since not all ground conditions are suitable. In addition, the detailed site investigation will establish the working width needed to accommodate the extra plant and equipment, and to store any additionally stripped topsoil.

6.4.25 Powered by a mobile rig, the drill enters the ground at a shallow angle to bore a small pilot hole. It is steered to follow a pre-determined constant radius to achieve the required clearance from the crossing. The drill emerges on the opposite side of the obstacle, normally within the space of a shallow pit. The diameter of the drilled hole is then increased incrementally by subsequent pull-throughs of a reamer or hole-opener, until the hole is of a suitable size for installation of the pipe.

6.4.26 A fabricated permanent length of pipe is connected to the end of the drill pipe by means of a swivel bearing, and the drill string rotated and withdrawn. As it is

withdrawn it pulls the pipe string into position behind it. This part of the gas pipeline is later tied into the remainder of the gas pipeline system.

6.4.27 Bentonite, a naturally occurring fine clay, is normally used as a drilling lubricant. It is pumped from tanks to the head of the drilling bit through the centre of the hollow drill pipe. The lubricant mixes with the drillings, which are forced back along the hole under pressure, and into a recycling plant to recover much of the bentonite.

6.4.28 The HDD technique is shown in Insert 6.13.

INSERT 6.13 – HDD RIG PULLING BACK THE PIPE-STRING

Examples of Potential Locations where Special Crossing Techniques may be Required

Hedgerows

6.4.29 Wherever possible, the gas pipeline will be routed away from hedgerows. However there are occasions where hedgerows cannot be avoided.

6.4.30 Construction techniques require that short sections of hedgerows be removed, although it is often possible to align the pipeline to cross at a naturally "weak" point.

6.4.31 For hedgerow crossings, a new hedge incorporating suitably matched indigenous varieties will be planted within a suitable double post and rail or post and wire fence, which is maintained until the new hedge is established.

Cultural Heritage Features

6.4.32 Areas of archaeological value, including those having statutory designation, are also treated as special crossings. The construction technique used for these crossings will depend on the nature and sensitivity of the area, but a restricted working width may be adopted. In addition, topsoil stripping may also be reduced, special arrangements for construction traffic may be included and special reinstatement methods required.

6.4.33 The approach to crossing these areas would be developed in consultation with the relevant authorities. More details are given in Section 15 (Cultural Heritage).

Existing Pipelines and Other Services

6.4.34 Prior to commencement of the detailed design a search for existing buried services / utilities will be conducted by GECL to identify any known and unknown services / utilities along the gas pipeline route. The search will be aimed at identifying the nature of the buried services / utilities and the associated owners / operators.

6.4.35 GECL is already familiar with most owners / operators, as the proposed gas pipeline route (for the most part) will run parallel with the existing CECL Power Station gas pipeline, for which the owners / operators of services / utilities along the route are already known.

6.4.36 Regardless of this, a detailed survey shall be conducted along the proposed gas pipeline route during the early stages of the pipeline design with a metal detector to confirm the location of all known existing buried services / utilities and also identify the location of any unknown buried services / utilities.

6.4.37 In addition, GECL will consult all owners / operators of buried services / utilities and Statutory Undertakers / Highway Authorities during the early stages of the pipeline design to establish:

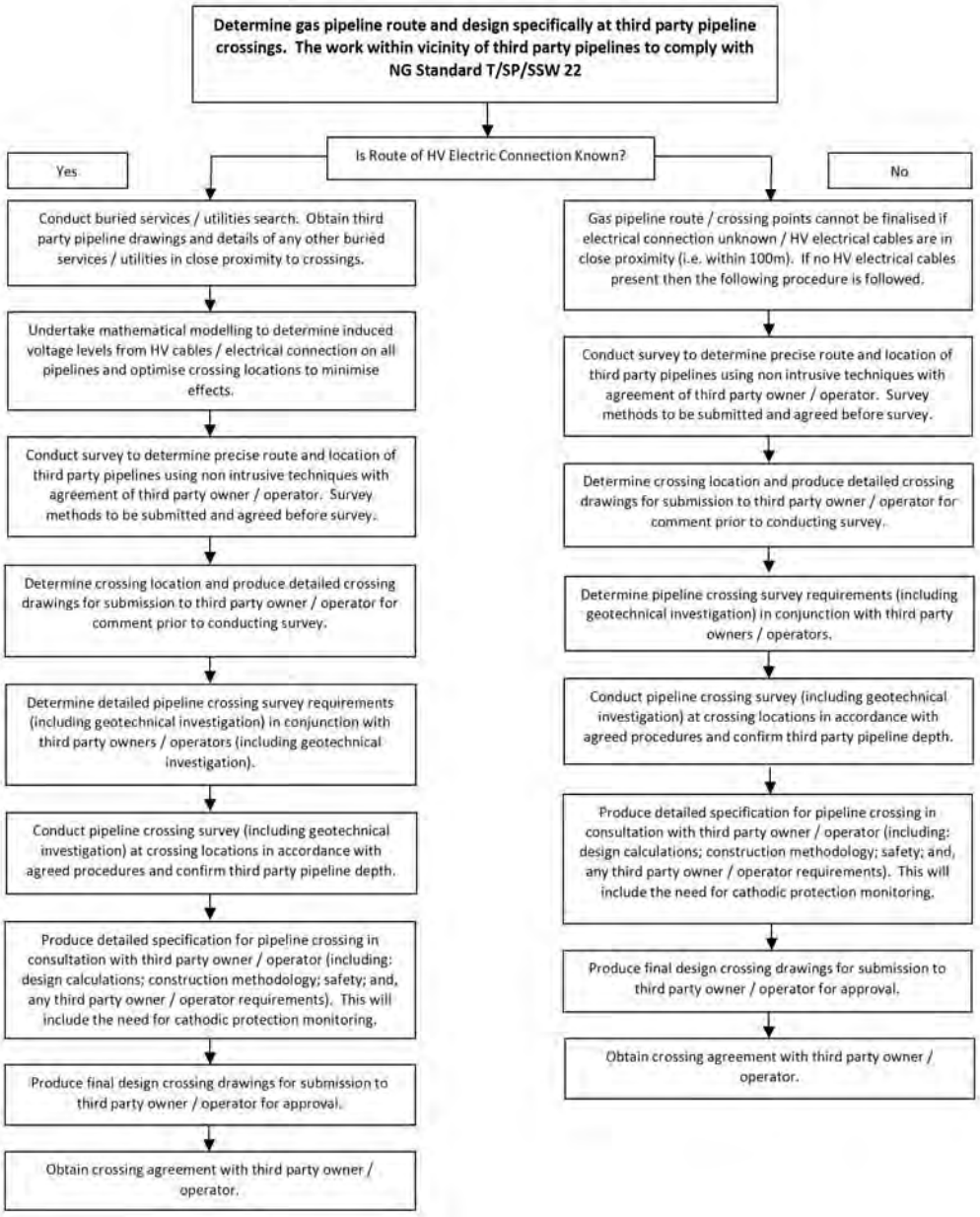
- Any requirements for work within their wayleave;
- Any special precautions that may be required to avoid damage to buried services / utilities; and
- Any special requirement for the design of the buried service / utility crossing.

6.4.38 Furthermore, crossings of third party pipelines / services / utilities by construction traffic (comprising construction plant, equipment and personnel) will only take place at locations agreed with the third party owners / operators. The crossings by construction traffic will be specifically designed to mitigate damage to buried services (For example: the use of bog matts to reduce the load on third party structures from construction traffic. In addition, fences will be erected at third party pipeline / service / utility crossing points to ensure .that construction traffic can only cross at areas where there is matting installed).

6.4.39 However, it should be noted at this time the precise crossing method for third party pipelines / services / utilities cannot be confirmed due to the fact that the detailed design of the gas pipeline route has to be undertaken in conjunction with the detailed design of the electrical connection route. However, in all cases the selected crossing techniques will aim to minimise both the risk of damage and level of any risk to any third party pipeline / service / utility.

6.4.40 Flowchart 6.1 summarises the process for determining the precise crossing method, detailing instances where the electrical connection route is known and unknown.

FLOWCHART 6.1 – DESIGN OF THIRD PARTY CROSSINGS



6.4.41 Following detailed design but prior to construction work commencing, the existing services and utilities crossed by / close to the gas pipeline will be positively located by trial pit excavation and / or by an indirect location method. Any work to locate third party existing pipelines / services / utilities will be carried out in conjunction with third party owners / operator's requirements.

6.4.42 The crossing methods selected will minimise the risk of damage to third party existing services and utilities both during the construction phase and during future operation of the gas pipeline. Wherever necessary, trenchless crossing techniques (such as those described above) will be employed to minimise the risk of damage to third party existing pipelines / services / utilities and any associated environmental impact.

6.4.43 All the above work will be carried under the guidance and supervision of the responsible service authorities' inspectors, as required. Flowchart 6.2 summarises the process.

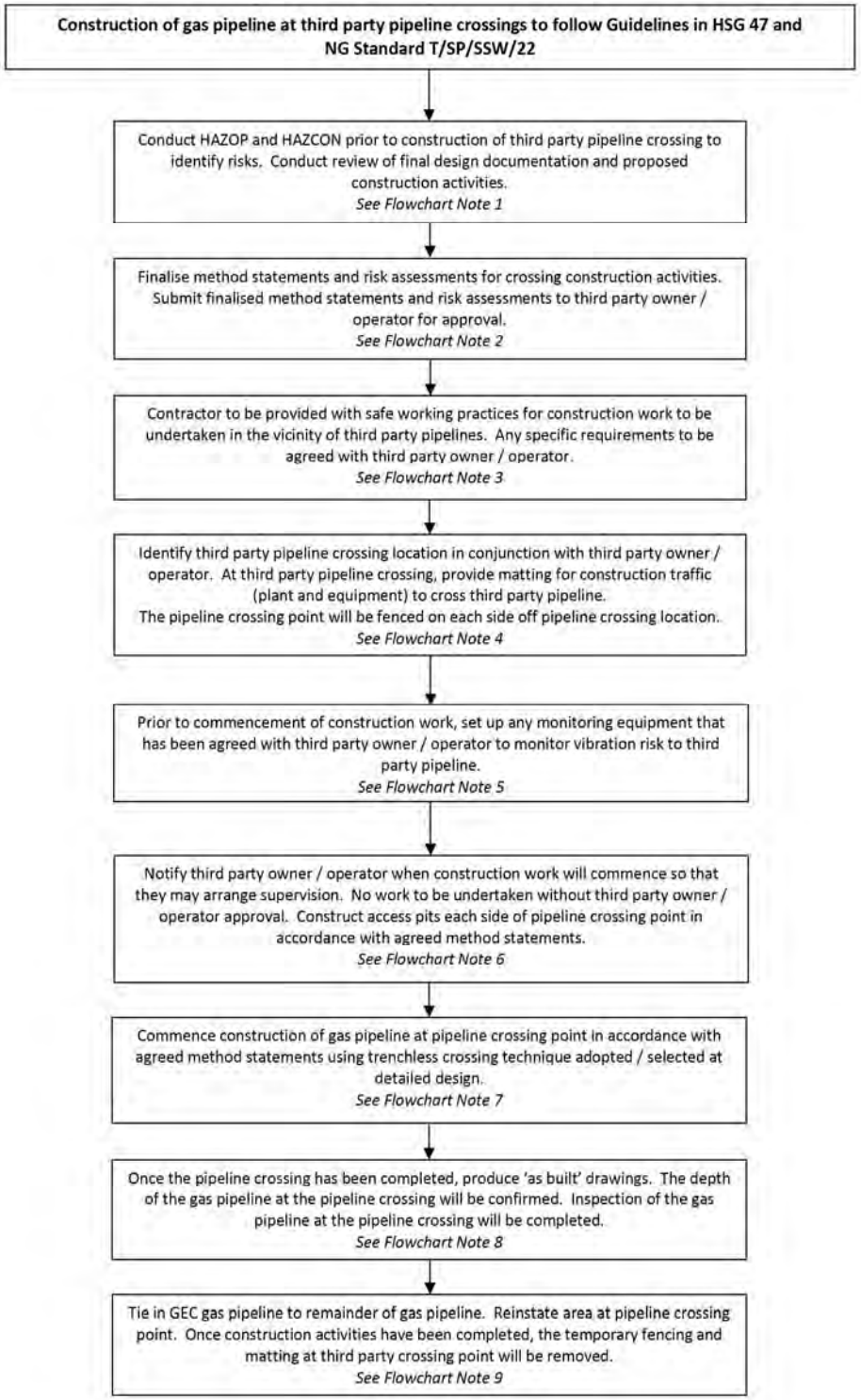
6.4.44 The requirements for crossing third party pipelines and buried utilities will follow the Guidelines given in HSG 47 "Avoiding Danger from Underground Services" and National Grid Standard T/SP/SSW/22 "Safe Working in the Vicinity of National Grid High Pressure Gas Pipelines – Requirements for Third Parties.

6.4.45 Construction activities in the vicinity of overhead powerlines will follow the guidelines given in HSE Guidance document GS6 "Avoidance of Danger from Overhead Powerlines". Additionally, where trenchless techniques are to be used, reference will be made to "Trenchless Techniques" (IGEM/SR/28 Edition 2) published by the Institute of Gas Engineers and Managers (2011).

6.4.46 In following these guidelines, together with the other procedures set out above (in Section 6.4), existing infrastructure along the proposed gas pipeline route will be identified along with its location and no physical works will be carried out in relation to the proposed gas pipeline without the prior agreement of the existing pipeline owner / operator (e.g. agreed risk assessments and method statements).

6.4.47 GECL notes that InterGen has an excellent health and safety record, including that in relation to crossing existing pipelines / services / utilities. In addition, the health and safety record of gas pipelines in general as proposed by GECL is excellent.

FLOWCHART 6.2 – CONSTRUCTION OF THIRD PARTY CROSSINGS



ACCOMPANYING NOTES TO FLOWCHART 6.2
Flowchart Note 1: Prior to any construction activities, a final HAZOP and HAZCON of the proposed design of the GEC gas pipeline at the third party crossings will be conducted by the GEC Construction Contractor in conjunction with the pipeline designer and GECL. The design drawings, third party owner / operator requirements, crossing methodology and any method statements or risk assessments already agreed will be reviewed. It is essential that open conversation between the GEC Construction Contractor, GECL and the third party owner operator is undertaken at this stage to determine the specific requirements for the proposed pipeline crossing. The third party owner / operator will be invited to attend the review.
Flowchart Note 2: The GEC Construction Contractor will finalise their method statements and risk assessments for completing the crossing of any third party pipeline / service / utility. The method statements and risk assessments will be based upon the crossing technique that has been adopted / selected as part of the detailed design. The final method statements and risk assessments will be issued to both GECL and the third party owner operator for review and comment. Comments will be incorporated in to the method statements and risk assessments and the documents will be issued.
Flowchart Note 3: The GEC Construction Contractor will meet with the third party owner / operator to: agree any specific safe working requirements; agree any third party owner / operator supervision / surveillance requirements; and be provided with a copy of the safe working practices that the third party owner / operator will require for the pipeline crossing construction work. The safe working practices will follow the minimum requirements given in NG Standard T/SP/SSW/22.
Flowchart Note 4: If no identification already exists, third party services / utilities will be marked / identified. Protective matting will be installed at the pipeline crossing working width to ensure that construction traffic (comprising plant and equipment) only crosses the third party pipeline at agreed and defined locations. Fences will be erected each side of the reinforced pipeline crossing to ensure that only the designated pipeline crossing point can be used by construction traffic.
Flowchart Note 5: Third party pipeline owners / operators may have specific requirements for vibration or other monitoring on their pipeline at the pipeline crossing point. If required, monitoring access points to the third party pipeline crossing will be constructed and the specified monitoring system installed. All work will be carried out in accordance with third party owner / operator requirements. No construction activities will commence until the monitoring system is installed.
Flowchart Note 6: The third party owner / operator will be notified prior to the commencement of any construction activities so that they can arrange for any supervision / surveillance of the construction works. Once the third party owner / operator is satisfied, construction works will commence. The third party owner / operator will be allowed access to the construction works, including their pipeline / service / utility, at their crossing points.
Flowchart Note 7: The trenchless pipeline crossing access points each side of the pipeline crossing will be constructed in accordance with the agreed method statements for the crossing technique adopted / selected. The GEC gas pipeline sections will be moved into position, fabricated and inspected to confirm the GEC gas pipeline meets the design code requirements. The installation of the GEC gas pipeline at the pipeline crossing will commence and measures will be taken to ensure that the GEC gas pipeline is at the required depth at the third party crossing point.
Flowchart Note 8: Once the pipeline crossing has been completed, 'as built' details of the pipeline crossing will be prepared. These will include the precise location and depth of both the GEC gas pipeline and the third party pipeline. Pipeline coating integrity checks will be performed.
Flowchart Note 9: At the pipeline crossing point, the GEC gas pipeline will be tied into the remainder of the GEC gas pipeline. The area at the pipeline crossing point will be reinstated. Once it is clear that no further construction traffic (comprising plant and equipment) will cross the third party pipeline, then the temporary fencing and protective matting will be removed.

6.5 General Pipeline Technical Considerations

6.5.1 The pipe material for the gas pipeline will be manufactured from high-grade steel in accordance with internationally recognised standards (C4 Gas PIPO and BS EN 10208-2). Thicker walled ('Heavy Wall' or 'Proximity') pipe will be used where added protection is called for in the pipeline design code IGE/TD/1, for example where the gas pipeline crosses roads, third party pipelines and railways or at locations where the gas pipeline is routed close to existing or proposed developments.

6.5.2 Pipeline construction will be confined to the fenced-off working width as shown in Inserts 6.1 and 6.2. This is normal practice for pipelines lying across open agricultural land. A site investigation survey will be undertaken before details of pipeline construction and crossing techniques can be finalised in consultation with relevant bodies.

6.5.3 The site investigation work will include geotechnical investigations using specialist contractors to drill boreholes and obtain soil samples at pre-identified locations. The survey will be conducted along the gas pipeline route and will gather data at all trenchless crossing locations to determine soil classification and strength and confirm the suitability of the proposed trenchless crossing technique at a given location. Risk assessments and method statements will be agreed with the existing pipeline service / /utility owner / operator prior to the geotechnical works being undertaken.

6.5.4 A land agent / consenting team will negotiate permanent rights of access for the gas pipeline in the form of a servitude. A servitude is a necessary requirement in order to gain access to the gas pipeline if and when the operator needs to carry out inspection, maintenance and repairs during the lifetime of the gas pipeline. As part of these agreements to be entered into with landowners and occupiers, some land-use controls are necessary to maintain gas pipeline integrity, for example exclusion of building within the servitude area. Normal agricultural activities can continue as before, except for those involving deep workings (over 300 mm) within the servitude area.

6.5.5 In agricultural land it is normal practice to provide a depth of cover of not less than 1.2 m over the top of the pipeline. At the road and rail crossings the depth of cover will be increased to meet the specifications of the consenting statutory authority and / or statutory undertaker. Installing a concrete slab and / or increasing the pipe wall thickness may be necessary to increase protection further where design considerations in accordance with the relevant codes and standards dictate.

6.6 Corrosion Protection

6.6.1 It is essential to protect the gas pipeline from external corrosion due to biological and chemical activity, or the risk of alternating current (AC) induced corrosion. This is achieved in three ways:

- By means of a high integrity anti-corrosion coating applied during manufacture of the pipe, with further coatings applied at the welded joints during pipeline construction;
- By installing an impressed current cathodic protection (CP) system to supplement the corrosion protection afforded to the gas pipeline by the anti-corrosion coating; and
- By the installation of an AC corrosion mitigation system to mitigate the risk of AC induced corrosion.

6.6.2 There will be no significant internal corrosion risk since the treated natural gas to be carried is dry and non-corrosive.

6.6.3 In designing the cathodic protection and AC corrosion mitigation system it will be necessary to carry out a soil resistivity survey along the route to obtain data to design the corrosion protection system. Other factors that may influence the design and location of the cathodic protection system are:

- Availability of a conveniently located power supply;
- The location of any other cathodic protection systems in the vicinity of the gas pipeline;
- The gas pipeline diameter, wall thickness, coating material; and
- Identified constraints and the recommendations of this ES.

6.6.4 The coating applied to the gas pipeline will be inspected and subjected to a 100 per cent holiday testing. The holiday testing is undertaken to test for coating defects / damage immediately before laying. A pre-commissioning and commissioning cathodic protection survey will be carried out and repeated at regular intervals during the lifetime of the gas pipeline as a continuing check on its condition.

6.6.5 In the event that full levels of cathodic protection are not to the required level then remedial work will be implemented. This will include ensuring the optimum protection from AC induced corrosion.

6.6.6 The impressed current cathodic protection system will involve applying a negative current to the gas pipeline. The local electricity utility will provide mains power to a cathodic protection system transformer rectifier (TR) unit or it may be possible to utilise the cathodic protection system for the existing CECL Power Station gas pipeline, which has spare current capacity and can provide cathodic protection current to the proposed gas pipeline.

6.6.7 The TR will allow the direct current for the cathodic protection system to be varied to suit the needs of the cathodic protection system. The groundbed is a series of anodes laid in a trench which is backfilled. Cables will run from the pipeline to the TR and from the TR to the ground-bed. If the existing CECL Power Station gas pipeline cathodic protection system can be utilised than then there will not be a requirement to install a new groundbed for the proposed gas pipeline.

6.6.8 Cathodic protection test posts will be installed at intervals of about 1 km along the pipeline route, normally beside road crossings for ease of access. Cables will be run from the test post to a welded plate on the pipeline with other cables installed for corrosion monitoring purposes and for connection of the AC corrosion mitigation system.

6.6.9 The pipe to soil potential being applied to the pipeline will be regularly monitored by experienced and qualified personnel to confirm the optimum levels of cathodic protection are being achieved.

6.6.10 Remote monitoring devices will be employed to regularly record the pipe to soil potential at critical locations.

6.6.11 A Close Interval Potential Survey (CIPS) will be carried out on commission of the CP system and at regular intervals throughout the lifetime of the pipeline. The CIP survey will help identify if there any areas where effective levels of cathodic protection are not achieved.

6.6.12 A Direct Current Voltage Gradient (DCVG) Survey will be conducted on completion of the pipeline installation to determine if there any coating defects that need to be exposed to carry out coating repairs to the pipeline.

6.6.13 An intelligent pig survey will also be carried out on the gas pipeline post construction. The intelligent pig survey will be carried out within a reasonable period of time after

commercial operation of the gas pipeline. The intelligent pig survey can only be carried out when there is gas flow in the pipeline.

6.7 Construction Constraints

6.7.1 Specific obligations will be included in the construction contractor's responsibilities to avoid or minimise environmental damage during construction and to avoid public nuisance. These include, as a minimum, the following requirements:

- To obtain construction consent approvals from statutory authorities, statutory undertakers and environmental bodies, in advance of gas pipeline construction;
- To ensure that all work is carried out within the agreed working width, using agreed accesses / egresses;
- To provide adequate notice to landowners / occupiers before commencement of works so that they have time to make any advance preparations;
- To ensure that all public roads affected by construction and / or construction traffic are kept clean and in a good state of repair;
- To maintain essential access for landowners / occupiers including passage of livestock;
- To maintain public paths affected by construction;
- To restore drainage systems, should any be affected by the pipe trench;
- To adhere to restrictions on the felling or lopping of trees;
- To maintain the working width in a clean and tidy condition;
- To store and use materials in an appropriate manner to minimise the potential for accidental spillage;
- To reinstate all land to the condition found, or as otherwise agreed;
- To abide by any conditions imposed by the approving authorities; and,
- To comply with the specific requirements of owners / operators of third party pipeline / service / utility and any Code of Safe Practice for work within their wayleave.

6.7.2 Normal working hours for general activities (such as top-soil stripping, welding, and pipe-laying / the movement of vehicles / the running of motorised plant and equipment) are 07:00 to 19:00 hours Monday to Saturday. No work on any Sunday or Bank Holidays is proposed to be undertaken. However, there may be exceptions to these working hours.

6.7.3 The exceptions to the working hours could be during non-destructive / pressure testing and commissioning and also in the event of special circumstances that may include HDD operations. These exceptions will be agreed with the Local Planning Authority.

6.8 Supervision of Construction Activities

6.8.1 A project management team will be appointed to oversee construction of the pipeline and all other facilities. This team will ensure that all works are carried out in a safe, efficient and professional manner and in accordance with the requirements of IGE/TD/1. Furthermore, they will insist that all works conform to best construction practice and are carried out in accordance with the requirements of all consents, authorisations or other permissions granted. They will also ensure that the terms of the operating licence are met following satisfactory inspection of construction and completion of pressure testing.

6.9 Operation and Maintenance

6.9.1 After the gas pipeline is fully commissioned, it will be operated and maintained in such a manner as to keep it safe and in good condition.

6.9.2 Helicopter fly-overs will be required to inspect the gas pipeline route. These fly-overs will be infrequent events (approximately one every two weeks) and will take place at the same time as the existing fly-overs for the existing CECL Power Station gas pipeline and the National Grid pipelines in the area.

6.9.3 The helicopter fly-overs would be aided by the presence of pipeline markers along the ground. It is currently envisaged that there will be approximately 15 aerial pipeline markers along the proposed gas pipeline route. The pipeline markers are approximately 2 m high. In addition, there may also be around 15 cathodic protection posts (approximately 1 m high) and 30 M4 mark posts (approximately 0.6 m high) at the special crossings.

6.9.4 Insert 6.14 shows a photograph of a typical pipeline aerial marker and cathodic protection post.

INSERT 6.14 – TYPICAL PIPELINE MARKER AND CATHODIC PROTECTION POST

6.9.5 The operation / maintenance of the gas pipeline will be carried out in accordance with the requirements of IGE/TD/1. Protective measures inherent to the gas pipeline design, together with regular monitoring, will ensure that major risk to the gas pipeline is virtually eliminated and so unlikely to cause damage.

6.9.6 Monitoring is normally carried out in the following ways:

- *Periodic Visual Monitoring*
  A "care and maintenance" team will carry out visual monitoring. Their duties will include regular vantage point surveillance by road and foot. Their observations will provide a record of changing ground conditions and third party activity along the gas pipeline route and prevent any unauthorised third party activity from compromising its safety. It is likely that the gas pipeline will be observed from the air every two weeks.

- *Pigging*
  "Intelligent pigging" will be part of the standard inspection and maintenance procedure of the gas pipeline, and will be carried out as a baseline run within a reasonable period of time following commercial operation of GEC. The gas pipeline will thereafter be subjected to "intelligent pigging" inspection at 5 yearly intervals, unless it is otherwise confirmed that the inspection interval can be increased. "Intelligent pigs" are special on-line inspection vehicles (OLIVs) which pass through the gas pipeline as an inspection exercise to check on the condition of the gas pipeline and detect any evidence of corrosion or damage.
- *CP Monitoring*
  This consists of monthly checks of the CP station TR unit and / or through the electronic monitoring system. At six monthly intervals pipe to soil potential measurements will be taken at the CP test posts.

6.9.7 Operation and Maintenance Procedures will be implemented. As part of these procedures an Emergency Plan will be prepared to cover contingency plans and remedial measures. The Emergency Plan will be completed in consultation with the Local Authority.

6.9.8 The Emergency Plan shall be prepared in accordance with the requirements of the Pipelines Safety Regulations 1996. In addition, a Major Accident Prevention Document (MAPD) shall be prepared in accordance with the requirements of the Pipelines Safety Regulations 1996, which shall detail the risks associated with the operation of the gas pipeline and describe how the risks would be mitigated during its operational lifetime. The MAPD would be updated as often as deemed necessary during the operational lifetime of the gas pipeline.

6.9.9 In summary, the gas pipeline system would be operated and maintained to meet the requirements of the Pipelines Safety Regulations 1996, with the pipe work within the overall AGI operated and maintained to meet the requirements of the Pressure Systems Safety Regulations 2000.

6.10 Decommissioning

6.10.1 The gas pipeline will be decommissioned when it reaches the end of its useful life. At that time detailed decommissioning procedures will be produced in line with prevailing best practice.

6.10.2 As recommended in the pipeline codes and standards it is likely that the buried pipe will be left in place and stabilised, as lifting the pipeline could cause a greater disturbance to the environment.

6.10.3 The AGI will likely be removed and the land reinstated to its original condition.

6.11 Framework for the Environmental Management

6.11.1 The EIA for the gas pipeline and associated AGI is a continuing process. It starts with the selection of the proposed pipeline route and passes through the following stages:

- Identification of impacts in the ES;
- Development of appropriate mitigation measures;
- Establishment of criteria for crossing sensitive sites;
- Effective management and control of the construction activities;
- Post-construction reinstatement;
- Post-construction auditing; and
- Effective management and control of the operational activities.

6.11.2 In order to manage the likely environmental impacts associated with the above stages, Appendix B details a Framework for the Environmental Management for the construction phase of the underground gas pipeline and associated AGI.

6.11.3 The primary objective is to ensure full compliance with all safeguards identified as being necessary during the EIA process, as well as any conditions which are likely to be written into the construction contract and any statutory obligations.

APPENDIX C.2 *Likely Significant Environmental Impacts of Typical Crossings Techniques*

Further Information is provided in Appendix C.1 (Updated March 2011 ES Section 6) which describes the different crossing techniques likely to be used during the construction phase of the underground gas pipeline.

The following Table is intended to be complementary to this Further Information and details the associated likely significant environmental impacts of the various different crossing techniques.

There are no likely significant environmental impacts expected during the operation of the underground gas pipeline and associated AGI based on the crossing techniques, and therefore the Table only assesses impacts during construction.

It should be noted that the majority of the environmental impacts are similar for the different crossing techniques. Consequently, the assessment in the following table relates to each of the crossing techniques described in Appendix C1 (Revised ES Section 6) unless otherwise stated.

Furthermore, it should be noted that the precise crossing method will be identified during the final design phase. The method for selecting the precise crossing method is detailed in the Further Information provided in Appendix C.1.

LIKELY SIGNIFICANT ENVIRONMENTAL IMPACTS OF TYPICAL CROSSING TECHNIQUE

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Air Quality	During construction, there is the potential for impacts on air quality along the gas pipeline route (working width) or at the drilling / exit sites due to the nature of construction work (dust emissions arising from activities such as excavating / earth moving) and the additional traffic generated at this time.	Impact on air quality will be managed and controlled through a Construction Environmental Management Plan (CEMP).	The residual impact is assessed as not significant.	CEMP
Noise and Vibration	During construction, there is the potential for noise and vibration impacts along the gas pipeline route (working width) or at the drilling / exit sites due to the nature of construction work (the use of noise generating plant / equipment) and the additional traffic generated at this time.	Noise and vibration impacts will be managed and controlled through a CEMP. Additionally, a method statement and risk assessment will be agreed with the third party owners / operators of existing pipelines / services / utilities prior to construction works being carried out. Where extra sensitivities exist to noise and vibration impacts (i.e. at third party pipeline / service / utility crossings) additional monitoring may be undertaken in agreement with the third party owner / operator.	Although all construction works will be undertaken in accordance with a CEMP, it is still likely that there may be minor, temporary local noise impacts at receptors located 100 to 300 m from the gas pipeline route. However, these impacts will be temporary in nature and the residual impact is assessed as not significant.	CEMP / Additional monitoring undertaken in agreement with third party owner / operator.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Landscape and Visual	Landscape impacts may arise on Local Landscape Character due to construction works along the gas pipeline route (working width) or at the drilling / exit sites. Visual impacts will arise from the presence of construction plant / equipment along the gas pipeline route (working width) or at the drilling / exit sites.	Construction works will be screened by hoarding, where practical, to mitigate landscape and visual impacts near to sensitive receptors.	Although mitigation measures will reduce potential landscape and visual impacts, it is likely that significant adverse impacts will arise during the construction phase. However, these impacts will be temporary in nature and the residual impact is assessed as not significant.	CEMP
Ecology	Ecology impacts may arise during the construction works due to clearance / disturbance along the gas pipeline route (working width) or at the drilling / exit sites.	Habitat / Protected Species surveys will be undertaken prior to construction works commencing on site. These will be undertaken in accordance with any third party land owner / occupier requirements. Areas where Protected Species are known to occur / areas which support ecological habitat will be avoided. Removal of habitat will not take place during the breeding season.	Post construction, any habitat which was removed will be re-instated. Therefore, the residual impact is assessed as not significant	CEMP / Agreement with third party land owners / occupiers.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Land Use	Temporary loss of productive agricultural land associated with the land take required along the gas pipeline route (working width) or at the drilling / exit sites (between 50 m by 50 m to 60 m by 60 m). In addition, land take will also be required to weld / test the pipe string and store excavated material prior to disposal.	Wherever possible, productive agricultural land take will be minimised during detailed design. The temporary land take will be subject to protection measures outlined in method statements and risk assessments (agreed with third party land owners / occupiers) and re-instated post construction.	Post construction, any land will be re-instated. Therefore, the residual impact is assessed as not significant	CEMP / Agreed method statements and risk assessments.
Geology, Hydrology and Hydrogeology	Contaminants (such as fuels and concrete) will be used on site (either along the gas pipeline route (working width) or at the drilling / exit sites). There is the potential for land contamination to occur as a result of spillages. If a trenchless technique is used (and a drilling technique is used) there is a risk of drilling fluid (bentonite) being released.	Impacts will be managed and controlled through a CEMP. Any works to be undertaken in the vicinity of third party pipelines / services / utilities will be in accordance with agreed method statements and risk assessments. Procedures will be put in place to deal with any pollution spills. Where hot spots are encountered, these will be remediated as necessary, in the appropriate manner.	The residual impact is assessed as not significant.	CEMP / Agreed method statements and risk assessments.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Water Quality / Waste	There is the potential for impacts on controlled waters to arise. If excavated material is not reused, it will require disposal. The extent of waste will depend on the amount of excavated material which can be reused.	Impacts will be managed and controlled through a CEMP and drainage strategy. No untreated water will be allowed to drain to controlled waters. Any works to be undertaken in the vicinity of third party pipelines / services / utilities will be in accordance with agreed method statements and risk assessments.	The residual impact is assessed as not significant.	CEMP / Agreed method statements and risk assessments.
Traffic and Infrastructure	Access along the gas pipeline route (working width) or at the drilling / exit sites would be required for the mobilisation / demobilisation of construction plant and equipment.	Traffic will be managed and controlled through a Construction Transport Management Plan (CTMP). Where extra sensitivities exist to traffic and infrastructure impacts (i.e. at third party pipeline / service / utility crossings) additional mitigation will be employed in agreement with third party owner / operator (i.e. temporary fencing to determine designated crossing points and installation of protective matting for reinforcement). This will also be reflected in the method statement and risk assessment that will be agreed with the third party owners / operators of existing pipelines / services / utilities prior to construction.	The residual impact is assessed as not significant.	CTMP / Agreed method statements and risk assessments.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Cultural Heritage	The cultural heritage in the area is well understood from the work undertaken for GEC and the LG Development. However, there is a potential for unknown cultural heritage features to exist. These will also have the potential to be impacted upon along the gas pipeline route (working width) or at the drilling / exit sites. In addition, there is a potential for the setting of cultural heritage features (i.e. Listed Buildings) to be subject to landscape and visual impacts along the gas pipeline route (working width) or at the drilling / exit sites.	A range of mitigation measures can be implemented. These range from: • Agreeing a plan of Archaeological Works to be used during construction (to be developed and agreed with the Essex County Archaeologist); • Using a targeted Archaeological Watching Brief; • Using soil stripping as an early construction activity to allow sufficient time for any investigation and recording to take place; and • Where possible, alteration of the construction technique to allow important features to remain *in situ*. Any works will be undertaken in accordance with any third party land owner / occupier requirements. Where extra sensitivities exist (i.e. at third party pipeline / service / utility crossings) additional mitigation will be employed in agreement with third party owner / operator.	Any cultural heritage / archaeological remains will be recorded and described as part of the targeted Archaeological Watching Brief. The residual impact is assessed as minor adverse / not significant depending on whether any unknown cultural heritage features are encountered. However, it should be noted that may also be positive effects associated with the discovery of unknown cultural heritage features which increase knowledge / understanding of a particular site.	CEMP / Agreement with third party land owners / occupiers / Agreed method statements and risk assessments.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Socio-Economics	There will be short term employment opportunities during the construction works.	The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	The residual impact is assessed as positive, albeit short term.	None Required.
Safety	There are a number of safety considerations which need to be implemented during construction of the gas pipeline both along the route (working width) or at the drilling / exit sites. These safety considerations will ensure that the gas pipeline can be designed, built and tested (i.e. constructed) in such a way that its integrity is not comprised during its operational lifetime. It addition this will ensure the integrity of third party existing pipelines / services / utilities.	The route (working width) and drilling / exit sites will be designed and constructed in line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation. In addition, method statements and risk assessments will be agreed with third party owners / operators of prior to any physical works being undertaken near to existing pipelines / services / utilities.	The residual impact is assessed as not significant.	Compliance with relevant Codes of Practice, Standards, Recommendations and Statutory Legislation. This will include agreement of risk assessments and method statements with owner / operators (such as Oikos, Shell and National Grid) prior to any physical works being undertaken near to existing pipelines / service / utilities.
Health	During construction, there may be the potential for impacts on health.	The aspects of the environment most likely to cause impacts on health are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan (HMP)	The residual impact is assessed as not significant.	CEMP (for other aspects of the environment listed above) / HMP.

APPENDIX D

SUBSTITUTION OF MARCH 2011 ES SECTION 15

D SUBSTITUTION OF MARCH 2011 ES SECTION 15

Introduction

The Further Information, in respect of the March 2011 ES Section 15 is provided in:

Appendix D.1 – Heritage Assessment

Gateway Energy Centre

UNDERGROUND GAS PIPELINE AND ASSOCIATED ABOVE GROUND INSTALLATION

HERITAGE ASSESSMENT

Prepared by

oxfordarchaeology
southsouthsouth

July 2011

Gateway Energy Centre

Gas Pipeline

Heritage Assessment

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Gateway Energy Centre

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1 INTRODUCTION

1.1 Project background

1.1.1 The proposed project includes the construction of an underground pipeline which will transport natural gas from an off-take to the west of Mucking village to the proposed Gateway Energy Centre Combined Cycle Gas Turbine (CCGT) power plant. The power plant will be located on land within a larger business and logistics park, the London Gateway (LG) development, which is currently in the early stages of construction and is the subject of a separate planning process. The Ordnance Survey (OS) Grid Reference of the Gateway Energy Centre site is 573209, 182165 (Figures 1-3).

1.1.2 The Thames Estuary is one of the great estuaries of Western Europe. It has been a focus for human inhabitation from the Palaeolithic through to the 20th century and throughout that period changes in the environment and sea levels have profoundly affected patterns of settlement, exploitation of natural resources and the use of the river for transport and trade. This dynamic relationship has left a rich legacy of archaeological remains and historic settlements along the river terraces. The Thurrock area is particularly rich in remains of all periods. In the modern era the same factors have made the Thames Estuary a magnet for industrial, residential and infrastructure developments, which can have a severe impact on these unique and irreplaceable heritage assets, if not carefully managed.

1.1.3 This report provides a description of the existing archaeological and cultural heritage assets within the pipeline route study area and the surrounding area, assesses their importance, and any impacts to them that may arise from development of the GEC gas pipeline and associated above-ground installations. Heritage assets considered include historic buildings, historic landscape, and known or potential archaeological deposits. In addition, the proposed mitigation measures are detailed, where appropriate. A summary of any residual effects after implementation of the proposed mitigation is also provided.

1.1.4 Historical maps show that the majority of the proposed gas pipeline route has not previously been developed (apart from the existing Coryton CECL Power Station gas pipeline). However, the surrounding area has been heavily industrialised, with developments such as the Shell Oil Refinery and its associated infrastructure, Coryton Oil Refinery, and CECL Power Station. The Shell Oil Refinery was closed in 1999 and most of the plant has since been demolished. Port Operator DP World obtained planning permission in 2007 to redevelop the site as the LG Commercial and Logistics Park, alongside a major new container port.

1.1.5 This assessment has been completed with reference to a desk-based assessment undertaken for the pipeline development. It also draws extensively on baseline studies carried out for the LG development, as the pipeline route falls entirely within the LG Environmental Statement (ES) study area (as considered at public inquiry in 2003, and subsequent baseline data updates, detailed below). The

proposed pipeline follows a very similar alignment to the existing Coryton Power Station gas pipeline. An archaeological watching brief on the construction of this pipeline, undertaken by Essex County Council Field Archaeology Unit (ECC FAU) in 1999, provides a valuable indication of the extent of archaeological remains along the proposed route.

1.2 Project description

1.2.1 The route of the pipeline is c 7km long, and runs from an existing pipeline terminal c 500m due west of Mucking village. The route passes to the south-east of Corringham and Stanford-le-Hope and to the north of the A1014 Manor Way, terminating within the former Shell Haven oil refinery, at the site of the proposed GEC power station (Fig.1).

1.2.2 Excavation of the pipeline will consist of the temporary stripping of topsoil from a working easement c 10m wide, and the excavation of a pipe trench. The pipe trench itself is expected to be c 1m wide and 3m deep. The pipeline working easement is considerably wider (c 10m), but will be stripped of ploughsoil only, to a depth of c 0.3m. The arisings will be stacked alongside the easement, which will be returned to agricultural use following reinstatement. It is assumed that pipeline construction traffic will generally be contained within the pipeline easement, but localised temporary access roads and works compounds will be required, where the easement itself is insufficient for access purposes. The construction method would normally comprise the removal of topsoil to a depth of c. 300mm, and the laying of geotextile and stone to form a temporary surface. On completion of the pipeline the surface will be removed and topsoil reinstated. Above-ground infrastructure will be constructed at the pipeline terminals. Road and watercourse crossings will be made using Horizontal Directional Drilling (HDD). The crossing of Mucking Creek will be by HDD at a depth of c 4m - 5m.

1.3 Key planning policies

1.3.1 The various legal and planning frameworks relevant to the proposed pipeline route are outlined below.

Statutory protection for historic buildings:

1.3.2 The Town & Country Planning Act 1990 and the Planning (Listed Buildings and Conservation Areas) Act 1990 together provide protection for listed buildings (as detailed in the statutory 'List of buildings of architectural or historical interest'). Protection for non-listed historic buildings is provided through application of relevant planning guidance (PPS5 - See below).

Statutory Protection for archaeological sites and monuments:

1.3.3 The Ancient Monuments and Archaeological Areas Act 1979 provides protection for archaeological sites and monuments included in the statutory 'Schedule of Ancient Monuments and Archaeological Areas'. While there are no currently protected archaeological sites within the pipeline route, legislation and planning guidance could be called upon to protect as yet undiscovered sites found in advance of, or during, development.

Planning Guidance:

1.3.4 The Town and Country Planning system provides a framework for the protection of 'cultural heritage assets' threatened by development, principally through the application of the relevant guidance notes:

1.3.5 Planning Policy Statement 5: Planning for the Historic Environment (PPS5), and the Historic Environment Planning Practice Guide. In PPS5, elements of the historic environment having historic, archaeological, architectural or artistic interest are collectively called 'heritage assets'. PPS5 includes policies for conserving or enhancing the setting of heritage assets in the development process (HE10).

1.3.6 In accordance with the guidance given in PPS5, wherever possible, any archaeological remains will be preserved in situ (in accordance with PPS5 HE7 and HE9, especially HE9.1 in relation to designated heritage assets). Where this cannot be achieved such remains will be analysed and the results published, to 'advance understanding of the significance of the heritage asset before it is lost' (PPS5, HE12.3). Policy HE12 also describes the policy principles guiding the recording of information related to heritage assets, including that the extent of a requirement should be proportionate to the nature and level of the assets' significance.

Relevant plans and policies:

1.3.7 East of England Plan - Section 8 - Environment; Policy ENV6: 'In their plans, policies, programmes and proposals local planning authorities and other agencies should identify, protect, conserve and, where appropriate, enhance the historic environment of the region, its archaeology, historic buildings, places and landscapes, including historic parks and gardens and those features and sites (and their settings) especially significant in the East of England.' Most relevant to the proposed pipeline are the following:

- The highly distinctive historic environment of the coastal zone including extensive submerged prehistoric landscapes, ancient salt manufacturing and fishing facilities, relict sea walls, grazing marshes, coastal fortifications, ancient ports and traditional seaside resorts
- conservation areas and listed buildings, including domestic, industrial and religious buildings, and their settings, and significant designed landscapes.
- the rural landscapes of the region, which are highly distinctive and of ancient origin and
- a wide variety of archaeological monuments, sites and buried deposits which include many scheduled ancient monuments and other important archaeological assets.'

Thurrock Local Development Framework

1.3.8 The 'Core strategy and polices for management of development proposal submission' (Thurrock Council, February 2010) is currently going through 'examination in public'. Draft policy CSTP24, 'Heritage assets and the historic environment' has been taken into consideration in compiling this EIA.

1.3.9 None of the saved Thurrock Local Plan policies are relevant to the cultural heritage aspects of this project.

2 ASSESSMENT METHODOLOGY

2.1 Content and presentation

2.1.1 This assessment follows the general order and content of the LG Environmental Statement's Cultural Heritage Chapter, which was compiled in light of 'Preparation

of Environmental statements for planning projects that require environmental assessment: A good practice guide' (Ref 1) and 'Standards and Guidance for Archaeologists.' Institute for Archaeologists (2001, last updated 2008) (Ref 2).

2.2 Desk-based studies

2.2.1 Available baseline cultural heritage data consists of :

- Archaeological desk-based assessment of the GEC development (PB January 2010, Ref 3)
- Environmental Statement (ES) for the Section 36 consent application for GEC (PB February 2010, Ref 4)
- Studies undertaken by Oxford Archaeology on behalf of P&O for the LG ES's (Refs 5, 6 and 7).

2.2.2 The LG ES, originally published in 2001, comprised three separate documents, in support of a series of interconnected applications, comprising:

- A Harbour Empowerment Order (HEO), in respect of the Port development (Ref 5)
- An Outline Planning Application (OPA) in respect of the Commercial Park (Ref 6)
- A Transport and Works Act Order (TWAO) in respect of transport infrastructure improvements (Ref 7)

2.2.3 For cultural heritage purposes a single baseline data set was compiled for the entire LG development area, against which each of the applications was assessed. The three ES documents covered overlapping study areas and were produced in parallel. Surveys and other supporting data were published as technical appendices, in separate volumes. Updates to the baseline dataset, including further non-intrusive archaeological surveys, were undertaken after the original publication of the ES, which resulted in updated ES volumes for each of the application areas. The pipeline route study area falls within all three of the LG ES study areas. Consequently any reference to the 'LG ES' in this chapter refers equally to all three.

2.2.4 The LG desktop study considered documentary, cartographic and archaeological sources, including results from previous archaeological investigations and from site visits. These were used to determine the likely nature, extent, preservation and importance of any archaeological remains that might be present within the LG development and surrounding area. Further up-dates were made in 2002 (Ref 9 and Ref 10). Following the granting of outline planning permission for LG in May 2007, further surveys and baseline data up-dates were carried out during 2008 (Ref 13 and Ref 14), at which time a comprehensive Cultural Heritage GIS was developed for the LG development and surrounding area, incorporating Lidar data, aerial photographs, cropmark plots, historic maps, Heritage Environment Record (HER) data, and British Geological Survey (BGS) mapping. The results from archaeological investigations (detailed below) have also been added to the GIS as they take place.

2.2.5 The LG ES baseline studies included detailed research into the industrial development of the area during the 19th and 20th centuries, and an assessment of past construction impacts within the floodplain caused by historic development of the Shell Haven site.

2.3 Deposit modeling

2.3.1 Previous work for the LG development has combined geotechnical Cone Penetration Tests (CPT), conventional boreholes and extensive electrical resistivity survey (Ref 17) to provide an understanding of the sub-surface stratigraphic architecture of the site. Limited radiocarbon dates and palaeoenvironmental analysis were also carried out as part of the original ES assessment (Ref 6; Ref 17).

2.3.2 The data contained in the deposit model derived from both geoarchaeological investigation and historical geotechnical data (Dames and Moore 1995, 1997, EMU Environmental Ltd, 2001, Environmental Resources Management (ERM), 2000, 2001, Fugro and McClelland, 1990, LTG Environmental Services, 1992 and Thyssen Geotechnical, 2001) as well as data from the BGS archive at Keyworth.

2.3.3 The ground investigation was shown to have productively combined various techniques to provide distinctive but complementary data. In particular it was possible to begin to model the early Holocene 'topographic template', i.e. the base of the Holocene alluvial sequence, where the surface of the gravels or bedrock marks the landsurface, prior to inundation following sea level rise in the early Holocene (c 6500 BC). This work indicated that the western part of the main development site consisted of steeper ground and a north-south trending step-like feature (possibly a buried Pleistocene terrace). The significance of the steeper ground and rising topographic template lies in the association with the shifting location of contexts likely to have been favoured by humans in the past. For example ecotonal niches (at wetland/dryland boundaries for example) often appear to have been the focus for prehistoric activity. The work has established that the Holocene sediments in the floodplain are c 12m - 15m deep in the former marshland areas occupied by the Shell Haven oil refinery. However, it was recognised that the data used to construct these maps was limited. The suitability of using such maps as predictive tools in archaeological prospection is limited by the accuracy and precision of the data sets used in their construction.

2.3.4 An up-date of the deposit model was undertaken in March 2008, comprising an additional 611 sample points, within and adjacent to the development (Ref 13), London Gateway: Updated deposit model interim report; client report for DP World). The majority of this data derived from recent geotechnical investigations (Environ 2004, Environmental Resources Management 2004, Fugro Engineering Services Ltd., 2004, 2005, Svitzer, 2003). Further BGS data was also added, along with some data from geotechnical investigations omitted from previous updates. The latter largely comprised shallow interventions that recorded the depth of made ground across the Port Development. Previous model updates concentrated on the deeper boreholes that penetrated the Pleistocene gravels, in order to map the early Holocene topographic template. It was, however, considered important to provide as much detail as possible on the distribution of made ground across the site, to inform assessments of construction impact within the alluvial floodplain.

2.4 Field surveys

2.4.1 Extensive field surveys have previously been undertaken for the LG development between 2001 and the present, a number of which overlap with the route study area, as detailed below. In addition, further aerial photographic plots, a walkover survey and borehole study have been undertaken specifically to investigate the pipeline route. Geophysical surveys have recently been undertaken at two potential National Grid sub-station sites, which could be the terminals for proposed

electrical connection routes connected with the GEC power station development (Ref 56). Taken together the survey coverage is extensive and includes much of the pipeline route, in particular the central section through Stanford-le-Hope and Corringham.

2.4.2 Sufficient data and other information is available from previous investigations in order to identify and assess the effects which the development is likely to have on the environment and upon heritage assets in particular. In particular, the proposed pipeline follows a very similar alignment to the existing Coryton Power Station gas pipeline - An archaeological watching brief on the construction of this pipeline, undertaken by Essex County Council Field Archaeology Unit (ECC FAU) in 1995, provides a valuable indication of the extent of archaeological remains along the proposed route.

2.4.3 Surveys undertaken in relation to LG, within the route study corridor include the following elements (Figure 3):

LG Environmental Statement:

- Surface artefact collection surveys LG ES - 2001-3 (gravel terrace) (Ref 6)
- Gradiometer survey LG ES - 2001-3 (mainly gravel terrace) (Ref 6)
- Rectified aerial photographic plots (2001-3, updated by ECC in 2011) (gravel terrace) (Ref 6; Ref 21)
- Preliminary Deposit Model (floodplain) (Ref 6)

LG Northern Triangle East (floodplain):

- Geoarchaeological assessment (Ref 16)
- A series of 20 trial trenches and a watching brief on ecology pond creation (Ref 16)

LG Stanford Wharf Nature Reserve (floodplain / terrace edge):

- Gradiometer survey (Ref 18)
- Geoarchaeological assessment (Ref 18)
- Resistivity profiles through alluvial sequence (Ref 19)
- Boreholes (Ref 19)
- Trial trenching (Ref 19)
- Open area excavation and watching brief (Ref 20)

LG Phase 1 Park Infrastructure (floodplain)

- Geoarchaeological deposit modelling, based on borehole data (Ref 13)
- Electrical resistivity profiles through alluvial sequence (Ref 17)

LG Access Road (floodplain and gravel terrace):

- Gradiometer survey (gravel terrace only; Ref 11)
- Earth resistance survey (at terrace/ floodplain interface; Ref 11)
- Electrical Resistivity/ auger profile (at terrace/ floodplain interface; Ref 11)
- A series of 36 trial trenches, 6 in the floodplain and 20 on the gravel terrace, most concentrated in the interface zone (Ref 11)

- (Open area excavation and watching brief is proposed as mitigation during construction)

Non-LG surveys

2.4.4 Subsequent surveys have been commissioned by National Grid in relation to two potential sub-station sites, to south-east of Corringham and south of Stanford-le-Hope, in connection with the GEC development (Ref 56). The survey areas are shown on Figure 3. The geophysical survey results have been reviewed for this EIA, and the survey areas included on Figure 3 (Ref 56).

2.4.5 Essex County Council Historic Environment Branch carried out a series of aerial photographic reconnaissance flights over the London Gateway area, taking advantage of exceptionally good cropmark visibility in summer 2009 and 2010. A separate report has been prepared by ECC Historic Environment Branch. The updated plots are shown on Figure 2 (Ref 21).

The route study area

2.4.6 The 'route study area' here refers to the main gas pipeline and associated above-ground infrastructure. A 500m wide study area is considered sufficient, in this case, for consideration of visual impacts to historic landscapes and buildings. Archaeological impacts are considered negligible, if a site lies at least 100m from the proposed route.

2.4.7 A gazetteer of known archaeological sites and finds has been compiled for sites within the pipeline route study area (Table 5) extracted from the LG Cultural Heritage GIS. For consistency, the identification numbers follow the LG ES Gazetteer numbers (up-dated as necessary; prefixed 'OA' in the following text).

2.5 Definition of criteria used in the assessment

2.5.1 Table 1 below contains the criteria used to assess the probable importance of receptor sites. It should be noted that virtually all of the known sites within the areas of proposed development do not fall under any national or local designation, other than Listed Buildings, and professional judgement has therefore been used to determine importance.

Table 1: Criteria used to determine importance of the receptor

Importance of receptor	**Equivalent to**
Very High (International/ National)	Sites of National Importance. Scheduled Monuments. Grade I and II* Listed Buildings. World Heritage Sites.
High (Regional/County)	English Heritage Registered Park and Garden. Conservation Area. Sites of Regional or County Importance. Grade II Listed Buildings.
Medium (District/High Local)	Important Sites on a district level. Sites with a District value or interest for education or cultural appreciation. Sites which are so badly damaged that too little remains to justify inclusion into a higher grade.
Low (Low local)	Important Sites on a local or parish level. Sites with a local or parish value or interest for education or cultural appreciation.
Very Low	Sites or features with no significant value or interest. Sites which are so badly damaged that too little remains to justify inclusion into a higher grade.

Importance of receptor	Equivalent to
Uncertain	Possible archaeological sites for which there is limited existing information. It has not been possible to determine the importance of the site based on current knowledge. Such sites might comprise isolated findspots or cropmarks visible on air photographs.

2.5.2 The determination of magnitude of change is based on the level of impact and the current state of survival/condition of the receptor. The survival of archaeological deposits within any given area is often uncertain, as is their exact extent. Magnitude of change can be difficult to predict with any certainty, for this reason. There are a number of variables in determining magnitude of change within the proposed development. These include the sensitivity or vulnerability of a site to change (for example, depth of alluvium, or the presence of made ground), the nature of past development or management impacts, and the differing nature of proposed development processes such as piling and topsoil stripping.

Table 2: Criteria used to determine magnitude of change

Magnitude of change	Description of change
High	Complete destruction of the site or feature. Change to the site or feature resulting in a fundamental change in the ability to understand and appreciate the resource and its historical context and setting.
Medium	Change to the site or feature resulting in an appreciable change in the ability to understand and appreciate the resource and its historical context and setting.
Low	Change to the site or feature resulting in a small change in the ability to understand and appreciate the resource and its historical context and setting.
Negligible	Negligible change or no material change to the site or feature. No real change in the ability to understand and appreciate the resource and its historical context and setting.

2.5.3 The significance of environmental effects for each aspect of the development proposal is determined by two variables:

- the importance and/or sensitivity of the receptor; and
- the magnitude of change/the impact.

2.5.4 This provides a general guideline as to how the significance of effects have been assessed.

2.5.5 The predicted environmental effect outlined in the table below represents the effect without mitigation.

Table 3: The significance of environmental effects

Magnitude of change	Importance/sensitivity of receptor				
	Very High (International/ National)	High (Regional /County)	Medium (District)	Low (Local)	Very Low (Site Specific)
High	Severe	Major	Major	Moderate	Minor
Medium	Major	Major or Moderate	Moderate	Minor	Minor
Low	Moderate	Moderate or Minor	Minor	Minor or Insignificant	Insignificant
Negligible	Minor	Minor or Insignificant	Insignificant	Insignificant	Insignificant
Uncertain	Uncertain	Uncertain	Uncertain	Uncertain	Uncertain

2.5.6 For the purpose of this assessment, definition of 'impacts' and 'effects' are as

defined in the Design Manual for Roads and Bridges (Ref 8).

3 GEOLOGY AND TOPOGRAPHY

3.1 Geological / topographical zones crossed by the pipeline route

3.1.1 For assessment purposes the route of the proposed pipeline route is divided into four zones, the boundaries of which are defined on geomorphic grounds, using BGS 1:50,000 drift geology mapping as follows (Figure 2):

- Zone 1 - Tidal Flats
- Zone 2 - Hassenbrook/ Mucking Creek (Alluvium and Taplow Gravel)
- Zone 3 - Undifferentiated Head deposits
- Zone 4 - River Terrace 3 gravels

3.1.2 In the following text Zones 1 and 2 together are referred to as 'The floodplain'. Zones 3 and 4 together are referred to as 'the Gravel Terrace'. Each of these zones have different characteristics, including age, formation, physical attributes and economic/ productive potential, that affect the character of the historic landscape and the distribution and survival of archaeological deposits. The archaeological potential of each Zone is discussed below. The interfaces between the geological zones are also significant in assessing the likelihood of archaeological discoveries.

3.2 Watercourses

3.2.1 Watercourses, including the Thames itself, have exerted a major influence in the evolution of the settlement pattern, which is reflected in the distribution of both archaeological remains and documented historic settlements. The route study area is traversed by several substantial watercourses (Figure 2), including the freshwater Hassenbrook at the point where it drains into the tidal Mucking Creek, and Carter's Creek, both of which are potentially affected by the pipeline route. Shell Haven Creek at the eastern end of the route may be peripherally affected. Fobbing Creek and Rugward Fleet fall partly within the study area but are not affected. Rugward Fleet and Oilmill Fleet are no longer extant, having been built over in the 20th century during development of the Shell Haven site. The line of Oilmill Fleet lies close to the pipeline route but is not directly affected.

4 BASELINE CONDITIONS

4.1 Palaeolithic period (500,000 - 10,000 BC)

4.1.1 During the warm phases of the Middle and Upper Palaeolithic periods southern Britain probably saw intermittent, possibly seasonal, occupation. Around *c.* 440,000 BC the climate became warmer and the first evidence for human activity is found in the London area, in the form of worked flint tools, from Hillingdon in west London.

4.1.2 After the last glacial maximum, and in particular after *c.* 13,000 BC, further climate warming took place and the environment changed from being a treeless steppe-tundra to one of birch and pine woodland (Ref 44). It was probably at this time that this part of England saw continuous, rather than seasonal, occupation. In

general there is significant evidence for increasing exploitation of the Thames Valley and its tributaries during the latter part of the Upper Palaeolithic (Ref 45, 54). The gravels of the Lower Thames have been found to be extremely rich in Palaeolithic sites, with large collections of material recovered during gravel extraction from a number of sites along the north bank of the Thames, in particular Purfleet and Grays to the west of the route study area (Ref 39, 5).

4.1.3 It should be noted that subsequent erosion has removed many of the land-surfaces on which Palaeolithic people lived and hunted. Consequently much of the evidence dating from this period takes the form of flint tools which have been swept from their original positions and redeposited in gravel terraces formed by rivers. Thus most of the Palaeolithic finds found to date are residual finds (located outside the context in which they were originally deposited), often discovered during gravel extraction.

4.1.4 Within the study area, a watching brief for the Corringham by-pass in 1969-70 revealed a Palaeolithic flint and scraper (OA71). On the northern edge of the study area small-scale quarrying activity produced a large number of flint implements, including Palaeolithic axes, from along the 21 m OD contour line (OA33). At the end of the 19th century Mr Smith and Reverend Wortham retrieved a large number of Palaeolithic implements and flakes in a gravel pit at Mucking, (OA7). This find lies c. 150m from the pipeline route, but the location has clearly been quarried. The extent of surviving gravel deposits is unclear on present evidence.

4.2 Mesolithic period (10,000 - 4,000 BC)

4.2.1 Within the route study area, Mesolithic flints have been recovered on various occasions during gravel quarrying between Fobbing and Corringham (OA75, 76, 78, 79) and during a watching brief on the Corringham by-pass (OA71). The NMR (but not the HER) describes one of these sites (OA78), discovered by Mrs Hart in 1970, as an occupation site, but provides no further information. At Fobbing, just outside the study area, a Mesolithic flint-working site was identified (OA80, HER entry). It is considered to be of some significance due to the quantity of worked flint retrieved and its undamaged condition.

The floodplain

4.2.2 Around 6,000 BC, sea levels rose and Britain became separated from the continent. Coastal areas gradually became submerged and people would have had to move further inland. The floodplain at London Gateway is estimated to have been entirely inundated by c. 6500 BC (Ref 17).

4.2.3 In the late Mesolithic and early Neolithic periods (4,000 - 3300 BC), there followed a marine transgression, due to melting ice sheets, resulting in rising water levels. The effect of the rising water levels on Mesolithic economy and settlement patterns is open to debate but probably entailed the abandonment of the low-lying areas of the floodplain and a shift further upstream or onto the valley (Lewis et al., 1992, 244).

4.2.4 The rising water levels would have covered the Thames floodplain with a succession of alluvial deposits. The vegetation rotted down in the rising waters (to form peat) and was subsequently covered by a succession of estuarine muds and clays. The wetland environment of the floodplain would not have been suitable for settlement but may have been utilised for a number of transient activities such as hunting and fishing.

The terrace

4.2.5 All of the Mesolithic sites and finds within the route study area are located on the edge of the gravel terrace, although as stated previously, evidence of Mesolithic activity on low-lying areas below the terrace would be covered by a substantial depth of alluvium. Throughout the Mesolithic period, the higher ground of the gravel terrace would have been dry land covered with a dense woodland and vegetation. Topographically, the terrace would have been a suitable location for settlement and hunting camps, within easy reach of the River Thames, which would have provided a reliable source of both food, from hunting and fishing, and water.

4.3 Neolithic period (4,000 - 2,200 BC)

4.3.1 The Neolithic is traditionally seen as the time when hunter-gathering gave way to farming and settled communities, when forest clearance occurred for the cultivation of crops and the construction of communal monuments.

4.3.2 Within the route study area there are chance finds of possible Neolithic worked flint in the vicinity of Corringham (OA71, 75 and 76). During the LG excavations at Stanford Wharf Nature Reserve, scatters of worked flint were found in the north-west corner of the site, at the interface between the terrace edge and alluvium (Figure 2). In the wider area Neolithic finds are sparsely distributed, with a slight focus around the Hassenbrook. The significance of the discoveries, all of which are located on the gravel terrace, is uncertain, but at least indicates the presence of human activity in the area. At the western end of the route study area, evidence of Neolithic activity in the form of pits, pottery and flint, was found in the 1965-77 Mucking excavations (Figure 2, Ref 31, p.32). Major monuments of this period in beyond the study area include a causewayed enclosure, found in Orsett (Ref 32, p.18).

The floodplain

4.3.3 Any evidence of Neolithic utilisation of the floodplain would be buried beneath later alluvium. The subsurface deposit model undertaken for the present assessment indicates that by the Neolithic period the floodplain areas (mapped by BGS as 'Tidal Flats') would have been entirely inundated, other than a 'ledge' of higher ground in the western part of the floodplain, which would have remained dry in the Neolithic period and suitable for settlement. It is also possible that there were islands of higher, dry, ground across the floodplain, which may also have been suitable for settlement.

4.3.4 The low-lying areas of the floodplain would have been a wetland environment prone to flooding. It is possible that this intertidal zone supported a number of transient activities such as hunting and fishing. The discovery of a wooden idol from the Dagenham marshes and possible ritual deposits and wooden platform at Fenn Creek, in the Blackwater Estuary, suggest that the coastal zone may have also been used for ritual deposition in the Neolithic period, similar to that seen in later periods (Ref 40, p.16).

The terrace

4.3.5 Throughout the Neolithic period the gravel terrace above the floodplain would have been covered with woodland and dense vegetation. It is likely that areas of the terrace were cleared for settlement, agricultural and possibly ritual/ ceremonial purposes, as indicated elsewhere in the Thames Valley (Ref 45 for London area and Ref 40, p.15 for Essex).

4.4 Bronze Age (2,500 - 700 BC)

4.4.1 The Bronze Age is characterised by increasing population and greater utilisation of the land in the form of open and enclosed settlements and associated field systems, in areas cleared of woodland. Throughout this period, the River Thames would have continued to serve as an important line of transport and communication, the London region gradually becoming an important centre both for the production of metal objects and for controlling their trade (Merriman 1990, 27). Elsewhere along the Thames, large quantities of metal objects dating to the late Bronze Age have been recovered from the riverbed, mainly through dredging in the 19th century. It is believed some of these finds may have been deposited during funerary rites and ritual activities (Ref 45, p.89 and 93; Ref 40, p.16).

The floodplain

4.4.2 The subsurface deposit model undertaken as part of this assessment has revealed that throughout the Bronze Age the whole of the alluvial floodplain was a wetland environment. Recent discoveries along the Thames estuary indicate that, in conjunction with settlement on the terrace, the intertidal zone of the floodplain, was utilised for a number of activities.

4.4.3 In recent years, marshland reclamation has produced a number of finds, including evidence of prehistoric settlement, wooden boats and paddles, a possible wattle fish trap, and the remains of wooden wharves and trackways extending into the marsh, such as those at Beckton, Erith and Rainham to the west of the proposed development (Ref 40, p.16). The trackways would have provided access across the marshy ground of the intertidal zone for a number of activities including grazing, fishing, fowling and salt manufacture. The waterlogged conditions and the 'protective' layer of alluvium often mean that the remains of any wood or organic remains are well preserved.

4.4.4 Evidence of salt manufacture in the Late Bronze Age is known from a number of coastal sites, in particular at Mucking (Ref 40, p.15). The route study area for the present assessment contains evidence of Late Bronze Age briquetage (the debris of pottery containers in which brine was evaporated for salt-production) on the edge of the floodplain (OA 74). Certainly by the late Iron Age, many of the coastal marshes in Essex would have supported salt-making industries. Salt-making sites typically comprise 'red hills' that were formed by an accumulation of briquetage (Ref 40, p.7). These are most commonly located at the very edge of the inter-tidal zone, but subsequent changes in coastline due to reclamation, can lead to ancient salt-making sites being found in what is now dry land.

The terrace

4.4.5 It is likely that the well-drained and fertile soils of the higher ground would have been utilised for settlement throughout this period. The dense woodland of the Neolithic had been cleared and the landscape would have been relatively open.

4.4.6 A major Bronze Age circular single-ditched enclosure, Mucking North Ring (250), was excavated prior to construction of St.Clere's Golf Club, and lies 300m north-west of the pipeline terminal, within the route study area (Bond 1998). Excavations at Mucking (*c.* 1 km to the west of the pipeline terminal) have also revealed extensive evidence of Bronze Age activity in the form of ring-ditches, field systems and another large circular enclosure, this time double-ditched. Mucking North and South Rings are sometimes interpreted as defensive in nature, and appear to have been strategically located to overlook the river Thames (Ref 32, p.18-19).

4.4.7 Cropmarks of ring-ditches (OA 12, and possibly 39) provide evidence of utilisation of the terrace near the pipeline route for ritual purposes. These are most likely to be burial mounds, but OA12 is large for a barrow (54m diameter) and could alternatively be a henge, or a settlement enclosure. The latter is less likely as there is no sign of internal features (Ref 21) .

4.5 Iron Age (800 BC - 43 BC)

4.5.1 The Iron Age is characterised by expanding population and worsening climate, necessitating the utilisation of previously marginal or difficult land (Ref 45, p.102). The route study area contains four known sites and finds dated to the Iron Age. None of these sites are located within the area of proposed development. The sites comprise:

- Evidence of occupation immediately alongside the proposed pipeline near Bluehouse Farm (OA1);
- The chance find of Iron Age pottery from a gravel pit c. 300 m to the south of the pipeline route (OA8);
- A sherd of Iron Age pottery found by chance c. 400 m north of the pipeline in 1970 (OA18);
- Undated prehistoric pottery, possibly of Iron Age date retrieved from Corringham Village in 1974 (OA74).

4.5.2 In addition, it is possible that cropmarks on the gravel terrace immediately to the west of the site (OA58) date to this period, although a medieval date seems more likely.

The floodplain

4.5.3 Although wooden structures of Iron Age (and Roman) date within the coastal marshes are found less frequently than those of the Bronze Age, this may be connected with differences in the speed and manner in which marine inundation occurred in those periods (Ref 40, p.16). It is almost certain that the marshes continued to be exploited in a number of different ways throughout the Iron Age. Any evidence of utilisation of the marshes that might be present would be located beneath subsequent alluvial deposits. Possible activities in the marshes would have included salt-manufacture fishing and fowling, and possibly pottery manufacture (using riverine clay deposits). Over three hundred salt-production sites are known in the Essex marshes. While most are of Roman date, it is clear that many originated in the Iron Age (Sealey 1996 quoted in EAA 1997, 29).

The terrace

4.5.4 Throughout the Iron Age the general pattern of known activity on the gravel terrace is characterised by small, dispersed farmsteads and agricultural utilisation in the form of extensive field systems and trackways (Ref 45, p.21). Excavations of a range of enclosed and unenclosed sites on the gravel terrace in east London, largely conducted by the Passmore Edwards Museum prior to gravel extraction in the 1980s, reveal that the gravels continued to be important for settlement and farming activities throughout this period (Ref 45, p.102). Excavations at Mucking, c. 600m to the west, revealed evidence of Middle Iron Age settlement in the form of open settlement of c. 110 round houses, with two, possibly three, nucleated settlements emerging in the later Iron Age (Ref 32, p.19). In the mid to late 1st century BC an imposing multivallate earthwork was constructed over the South Rings (see above), reflecting the continuing importance of the terrace area in the

control of traffic along the Thames.

4.6 Roman period (43BC - AD410)

4.6.1 In the Roman period, London developed as an urban centre and later the provincial capital at the centre of Roman Britain's communication system (Ref 45, p.124). The increase in the distribution and volume of traded goods, waterfront structures and vessels suggest that river traffic increased dramatically during the early Roman period.

The floodplain

4.6.2 The Essex marshes in the Roman period were home to an important salt-making industry. Approximately 300 salterns have been recorded in the county. They are known as redhills due the characteristic spoil heaps of briquetage and other detritus arising from the salt production process. Taylor (Ref 52) has noted a connection between the distribution of salt-making industries and the major urban centres of Roman Britain. It is very likely the Essex industry developed in response to the rapid growth of London in the 1st Century AD.

4.6.3 A Roman saltern is recorded within the route study area on the southern bank of Fobbing Creek (OA88).

4.6.4 Recent excavations during construction of the LG Stanford Wharf Nature Reserve in 2009, revealed almost the entire plans of two Roman salterns in a 16 Ha excavation area (OA9). This very extensive investigation has greatly increased understanding of the salt industry of Roman Essex. The sites are located on the very edge of the gravel terrace, with saltern mounds and working areas extending into the inter-tidal zone. The most extensive of the salterns lay on the east bank of Mucking Creek, next to Stanford Wharf. The smaller saltern lay 700m to the east, next to a small unnamed creek. This site is certainly the source of Roman pottery and other finds made periodically along the Thames foreshore at this location (OA9, 10, 43, 44, 7002).

4.6.5 There are slight indications that the site begins in the Iron Age, but most of the activity is dated within the Roman period. Key evidence included channels dug to catch salt water, clay briquetage coarsely formed into trays, containers and supports, and evaporation hearths over which the briquetage vessels were placed. Traces of low mounds or 'red hills' formed a slight ridge along the north edge of the site in one area. Working platforms appear to have been built out into the intertidal zone using masses of 'redhill' material (comprising crushed briquetage mixed with soil). In the early Roman period a structure constructed on large timber piles is interpreted as a possible boathouse. The mid-Roman phase (c AD 250 - 350) featured a large roundhouse set within in a rectangular enclosure next to Mucking Creek.

4.6.6 Salt extraction in the late Roman period (c AD250 - 400) appears to have been organised differently compared with the early Roman salterns. A large, robust hearth of this phase survives almost intact; it formed a low circular structure built from two courses of tile, with three raised pillars, perhaps to support lead tanks. The late Roman area included a very unusual building with a circular clay floor surrounded by a shallow gully. The building would have been supported by four massive posts built on post-pads of chalk and flint rubble, set in the base of square pits. This is currently interpreted as a large salt store, or possibly a watchtower (OA9, Ref 20).

4.6.7 Salt would have had an important impact on the regional economy and diet,

allowing large-scale processing of surplus meat and fish (Ref 45, 154). The excavations at Stanford Wharf Nature produced graphic evidence for this in the form of a deposit consisting almost entirely of eel bones, possibly resulting from the production of garum, a salted preserve popular in the Roman period. Finds of perforated cattle shoulder bones from the site suggest that meat was also being salted on the site. The food preservation industry at Stanford Wharf seems to date from the late Roman phase.

4.6.8 The alluvial clay of the marshes may have also been exploited for pottery, tile and briquetage production and the 'red hills' may have provided convenient raised areas for grazing sheep, or temporary occupation by shepherds in this, and later, periods (Ref 40, p.7 and 18).

4.6.9 Throughout the Roman period the climate became warmer and drier (Ref 31, p.4). The Romans brought elaborate fen-engineering technology with them, developed in the Mediterranean region, and are thought to have actively drained fenland in various parts of the country, such as Cambridgeshire, Norfolk and Lincolnshire (Ref 49, p.383). It is possible that some attempt was made to drain low-lying areas in Essex, possibly by constructing banks along the edge of the mudflats, although there is no evidence for that in the Essex marshes at present.

The gravel terrace

4.6.10 The western end of route study corridor contains important evidence of Roman settlement on the gravel terrace. At Mucking (Figure 2) c 600m to the west of the pipeline, extensive excavations between 1965 and 1977 revealed that this area of higher ground comprised a planned landscape parceled up into a series of ditched enclosures during the Roman period, with hillsides serving as the focus of industrial activities (Going in Clark 1993, 20). There were also cemeteries of Roman date. This landscape has sometimes been interpreted as the outskirts of a villa complex, the villa itself presumed to be outside the excavated area to the south (near Walton Hall). At any rate this settlement must have been an important local centre, as it had been during the preceding prehistoric periods.

4.6.11 Other burials in the vicinity of the pipeline include Roman burials of the 2nd century AD, found c 100m to the north of Mucking Village (OA6), and another within Corringham Village (OA74).

4.6.12 Other finds on the gravel terrace in the vicinity of the pipeline route include Roman pottery and tile from a watching brief near Corringham (OA63 and 64), and a number of chance finds of pottery, which are clustered along the banks of the Hassenbrook (OA2, 4, 18, 20). It is possible that some of cropmarks on the gravel terrace immediately west of the site (OA164 and 58) date to this period, but a medieval date is perhaps more likely for the majority (discussed in following sections). The general distribution of Roman finds along the Hassenbrook suggests that it may have formed the principal focus of the local settlement pattern in the Roman period. It is worth noting that various Roman finds have been made at the north end of the stream valley in the vicinity of Hassenbrook Hall (outside the route study area), including evidence for burials (OA24, 25, 26, 27), as well as pottery, tile, timbers and a possible well, found in the Hassenbrook valley itself during construction of the Stanford-le-Hope by-pass (OA276, 287).

4.7 Early medieval period (AD410 - 1066)

4.7.1 The route study area contains three archaeological sites that can be dated to the early medieval period, all of them located to the west of Bluehouse Farm, Mucking (OA 251, 244) c 200m from the western end of the pipeline. OA 251 is an early

medieval settlement site, found during excavations at Mucking North Ring (a large circular Bronze Age enclosure - OA 250). The early medieval evidence from this site included a sunken-featured building and early medieval pottery. Further early medieval pottery has found nearby (OA 244), within 100m of the pipeline route, in the same general location as finds and features of Iron Age and Roman date. These finds may be a continuation of a series of very extensive multi-period settlements and cemeteries found in the Mucking excavations (1965-1977). This 18 Ha excavation area included some of the most extensively excavated early medieval settlements and cemeteries in the UK. The Mucking excavation area archaeological features map is shown on Figure 2, in relation to the pipeline route. The early medieval site, which was established on a site that been extensively occupied in the Bronze Age, Iron Age and Roman periods (see preceding sections), is thought to represent a single settlement that gradually shifted location along a sandy ridge of the Orsett Heath gravel terrace, between the 5th and 8th centuries AD (Hamerow, 1993). Thereafter the settlement may have shifted again to an unknown location outside the excavated area, perhaps to the present site of Mucking Hall and Village to the east, or Walton Hall to the south.

4.7.2 The pipeline corridor passes through the ancient parishes of Corringham, Stanford-le-Hope, Fobbing, and Mucking. The former boundaries between the three parishes run through the route study area, and are marked on Figure 2. These boundaries, which may have origins in the early medieval period (or earlier), may once have been marked in some way, such as by a bank, fence or ditch. The parish boundaries as shown on the OS 1st edition 6" map (surveyed 1863) do not appear to follow the line of any natural features, so it is possible that they may have been demarcated artificially.

4.7.3 Domesday Book (1086) mentions the manors of 'Hassingbrhoc', Corringham, Fobbing and Mucking (discussed in the following section). Sherds of early medieval pottery have also been found by chance to the south-west of the Fobbing parish church (OA78).

The floodplain

4.7.4 It is clear that during the early medieval period and in later periods the coastal marshes were important for sheep pasture. Darby has plotted the location of Domesday manors in Essex which possessed pasture for sheep (Ref 33, Fig. 64) and found that all the villages with pasture for sheep lie in a belt parallel with the coast, abutting the marshland. The importance of sheep pasture is also indicated by the fact that inland parishes in Essex often owned a detached portion of the coastal marshes. The former parishes of Corringham, Stanford-le-Hope, Fobbing and Mucking follow this general pattern; in owning a part of the marshland each manor would have access to good pasture and an intertidal area where a number of economic activities such as fowling and fishing could be undertaken. The considerable number of sheep listed in Domesday Book for each manor highlights the great importance of pasture in the economy of the manors. For Corringham, Domesday Book lists 400 sheep before the Conquest and 500 after; for Fobbing it lists 700 sheep. Domesday Book also mentions a mill and a fishery for Mucking. It is not known where these were located.

The terrace

4.7.5 As with many of the early medieval manors in the coastal area of Essex, the manors of Corringham, Stanford-le-Hope, Fobbing and Mucking all abutted the edge of the coastal marshland (Ref 40, 7). This would have allowed the community to exploit a number of resources, including the fertile and well-drained soils of the terrace for arable cultivation, while at the same time having access to

the marshland for good pasture and other economic activities.

4.8 Later medieval period (AD1066-1550)

4.8.1 The route study area contains a number of known sites and finds of later medieval date (OA 10, 14, 42, 57, 64 and 161). These sites are discussed below. In addition, the route study area contains a number of extant medieval buildings, all of which are Listed Buildings located in the historic centres of Mucking and Corringham (see Section 8, Figure 3 and Table 4).

The floodplain

4.8.2 It is uncertain exactly when sea defences were first constructed to protect the Corringham and Fobbing marshes prior to draining and reclamation, although it is possible that some attempts were made to protect the marshes from flooding during the later medieval period. There are documentary references to the granting of commissions for the review and repair of the marsh defences in Essex as early as the 13th century, when the responsibility for sea defences would have lain with the tenants. By the 14th century, a rise in sea level led to the construction of seawalls along sections of the coastal marshes of Essex (VCH Essex vii 185). It is possible that such a barrier was constructed around the edge of the Corringham marshes at this time. It is probable, however, that the large scale, systematic reclamation that has survived to the present was carried out in the post-medieval period, specifically the early 17th century (discussed in the following section).

4.8.3 Archaeological investigations at Canvey Island, outside the study area to the east, produced evidence of a large number of oyster storage pits, probably dating to the medieval (and later) period, along with numerous fish-traps and duck decoy ponds (Ref 53, 207-210). These investigations also provide an insight into the significance of sheep grazing on the marshes. Here, excavation of a 'red hill' produced, above Roman levels, a series of medieval midden (rubbish) deposits almost 1 m thick, which yielded remains of hearths and pottery from the 12th to 15th centuries. The deposits probably represent the remains of temporary settlement by shepherds (Wymer and Brown 1995 quoted in Ref 40, 18). Those areas of marshland that were not reclaimed would have continued to be exploited for a variety of purposes and the importance of coastal trading, fish and shellfish in the medieval and post-medieval period is well known (Ref 40, 18). Fishing and the use of boats in the creeks within the marsh may have led to the preserved remains of sunken or abandoned boats.

The gravel terrace

4.8.4 The later medieval settlement pattern of the area, as deduced from historic maps, documentary sources, and the distribution of historic buildings, is characterised by compact villages - Mucking, Fobbing and Corringham - which are clustered around the Parish churches and the heads of the major creeks. All three of the villages in the route study area are named in the Domesday Survey of 1086. Both Corringham and Fobbing parish churches date from the 11th century (OA158 and 147). The village centres existed alongside dispersed agricultural manors and lesser farming estates, which, on the Tithe Award map of 1840, account for most of the agricultural land in the parishes.

4.8.5 In the case of Corringham, Fobbing and Mucking the most important manorial centres are located in or very close to the village centre. The settlement pattern in Stanford-le-Hope is more dispersed: In the Domesday Survey of 1086 two estates are listed under the name *Hassinghbroc* (the name Stanford-le-Hope does not

appear). From the 13th century there were three main manorial estates within the parish - Hassenbrook Hall in the north of the parish (OA123), Abbotts Hall to the east (OA32), and Cabborns to the south (OA14) - of which Hassenbrook Hall remained the largest and most important manor until the 20th century. The early importance of Hassenbrook Hall suggests that the higher ground in the northern part of the parish is the primary settlement area in Stanford-le-Hope parish, and that the terrace edge settlements within the route study area may be secondary. The Hall itself is located at the head of the Hassenbrook stream valley (outside the route study area to the north), in an area with evidence for Roman settlement (described above).

4.8.6 Cabborn's Manor may well be the second land-holding mentioned in Domesday under the name *Hassinghbroc*, as it lay at the southern end of the Hassenbrook valley. In the 18th century some of the marshland farms in the area were owned or farmed by London merchants or their agents. Cabborn's provides some evidence that this pattern may have extended back to the medieval period. In the late 15th century the estate was held for a time by a London-based grocer, William Hengsey (Ref 24).

4.8.7 The site of the former village green and the parish church of Stanford-le-Hope (OA 126) is located on rising ground near the western parish boundary, where the London Road crosses the Hassenbrook. Although not a manorial site, this location has historically acted as a market and focus for settlement, eventually developing into Stanford-le-Hope town centre. The Church of St Margaret of Antioch in Stanford-le-Hope is mainly 14th century but has 12th century remains (OA 125) indicating there was a settlement here by at least this date. Stanford-le-Hope and Mucking wharves are located on opposite banks of Mucking Creek, close to the mouth and certainly appear in their present locations on the Chapman and Andre Map of 1771. They presumably existed in earlier periods, but might well have shifted downstream, as a result of silting in Mucking Creek.

4.8.8 There are a number of lesser estates in the south-eastern part of the parish mentioned in documentary sources (Figure 2). Of the settlements within the route study area, Mucking village, Cabborns Manor (OA 14, destroyed by quarrying in 1938), Broadhope Farm (OA41, no longer extant), Old/ Great Garlands Farm (OA56), and Old Hall (OA161), and Corringham village, are located on slightly higher, drier areas of terrace gravel (avoiding the clay Head deposits), presumably to avoid the worst effects of floods. The village of Fobbing does not follow this trend, being located in an area mapped by the BGS as Head deposits. This village is located at the head of a major creek, which may have over-ridden the apparent preference for building on gravel. Even the settlements on the higher, drier ground were located close enough to the terrace edge to permit ready access to the river Thames, via trackways and minor tidal creeks. Mucking and Cabbon's Manor are both located on the very edge of the gravel terrace, on the banks of Mucking Creek / Hassenbrook.

4.8.9 Of the manorial and lesser farming estates in the route study area, Cabborns Manor, Old Garlands Farm and Old Hall, Corringham, are all documented by the 15th century and may have existed as separate estates in earlier periods. As noted above, Cabborn's Manor (OA14) may be identified as the smaller of the two estates listed in Domesday Survey (AD 1086) under the name *'Hasinghebroc'*. The group of small estates in the south-east of Stanford-le-Hope, including Old Hall (OA69), Broadhope Farm (OA41) and Old Garlands Farm (OA56) are located among their respective arable fields, which at the time of the 1840 Tithe Map lay broadly between High Road and the edge of the gravel terrace. In addition, each estate included extensive marshland pasture, comprising both 'fresh marsh' (ie, enclosed by a sea wall) and unenclosed 'saltings' or 'waste' (Ref 23). Artefacts

recovered from archaeological investigations within the lands of Old Garlands and Broadhope Farm (discussed below) suggests that these settlements may have originated c AD1200, although the finds to date have been found at probable wharf sites along the adjacent Thames foreshore rather than at the farms themselves.

4.8.10 Documentary evidence that Old Garlands Farm may have existed as a separate estate in the medieval period comes from a 13th century land grant relating to the Petre Family of Ingatestone and Horndon, which was witnessed by a group of south Essex notables including Peter de Stanford and Robert de Garlande (Essex Records Office - D/DP T1/139). 'Old Garlands Farm' was acquired by Sir John Hawkins (one of the leading English seamen of the Elizabethan period) in 1591 and was given by him as an endowment for a hospital that he founded in Chatham for sick and elderly mariners. The Hawkins Hospital, which still exists, owned the estate from 1592-1920 and has extensive surviving records covering that period. Although there is no certain documentary evidence to suggest that Hawkins ever resided there, it may be no coincidence that his last flagship, launched at Deptford in 1590, was called 'Garland' (Essex Records Office - D/DP T1/139). The estate owned by the Hawkins Hospital is variously referred in the estate records as 'Old Garlands Farm', 'Garlands Farm', 'Old Garlands Den' and 'Great Garlands'. The 'den' element suggests that this estate may have originated as a detached portion of an 'upland' parish, a common arrangement in south Essex, through which parishes with no river frontage had access to the marshes for summer grazing. Flood events are occasionally referred to in the manorial records - For example, the tenants complained of the disastrous effect on their livestock and corn of severe Thames floods in 1735 (Ref 23). The estate records include a draft "to be let" notice for Old Garland's Farm, dated c. 1750, which is described as 'messuage, barn, stable, 30 acres upland, 87 acres fresh marsh land and 15 acres salt/waste land' (the medieval estate was probably larger as the lands forming Little Garlands seem to have sold off at some point prior to the early 18th century). According the historic maps the head of Carter's Creek, and the marshland beyond, was accessed by a series of trackways leading from Old/ Great Garlands and the 'High Road' to the north-west, (principally the 'Manor Way' track).

4.8.11 A medieval archaeological site of particular interest within the route study area was first discovered to the south of Great Garlands Farm during a watching brief by ECC FAU on the Coryton Power Station gas pipeline in 1999 (OA57, Ref 25). A further group of late medieval/ early post-medieval features was also identified during trial trenching in the proposed LG Access Road corridor (Figure 2, Ref 12). The earliest features on both sites are a series of medieval drainage ditches, some of which were in-filled with dumps of domestic rubbish dating from the 12th - 14th centuries. The ditches were sealed by alluvium in some places (probably flood deposits). The most significant features date from the 15th-16th century and were concentrated in the 1995 ECC FAU excavation area. Taken together, these two sites probably represent a late medieval/ early post-medieval wharf at the head of 'Carter's Creek' (Figure 2). The 1840 Tithe Map names one of the fields in this area 'Saw Pit Field' (OA184) which suggests that wood-working, and very likely boat-building, took place at this location in the post-medieval period. If the 1999 gas pipeline and LG Access Road sites are part of a continuous linear settlement along the edge of the gravel terrace, its total extent would be c 600m, from the Manor Way track in the north, to the proposed LG Access Road centreline in the south. The inland extent of the settlement is uncertain, as the gas pipeline excavation was only 20m wide. There is no indication of cropmarks or geophysical survey anomalies extending inland, but this may be a matter of poor visibility on the Head deposits by comparison with the gravels. Within the LG Access Road corridor the 12th-16th century features appear to be confined to a

narrow strip, no more than 50m wide, closely following the edge of the terrace, which would have been tidal foreshore prior to land reclamation in the 17th century.

4.8.12 The ECC FAU excavation revealed a considerably wider range of features and artefacts than are apparent in the LG Access Road trial trenches, including more direct evidence for structures, and stratified occupation deposits. They included two cobbled surfaces (the largest 25m wide and 0.2m thick). Given the landscape context, close to the head of a large tidal Creek, these surfaces are perhaps best interpreted as 'stands' for pulling boats up onto the shore. The largest cobbled surface lay alongside a broadly contemporary large, rectangular timber building (10m by at least 9m). The cobbled surface was partly overlain by an 'occupation layer' which produced a variety of finds including: 'the handle of a late medieval copper alloy chafing dish, an almost complete late medieval Surrey white ware dripping dish, and a 16th century carved bone toothpick with a head in the shape of a unicorn'. A second, smaller cobbled surface, possibly a kiln or oven, a pit, postholes and other features, were also recorded in the same area (Ref 25).

4.8.13 The area of medieval activity south of Great Garlands Farm is located at the very edge of the gravel terrace. The earliest map consulted, Chapman and André's map of 1771, clearly shows a creek extending through the marshes to the foot of the terrace at this point, which is named as 'Carter's Creek' on the 1st Edition OS. The surviving earthworks at that location support the interpretation of the site as a wharf, noting a flat area surrounded by a substantial *(*c 2 m high) sea wall (OA166) at the foot of the terrace immediately south-east of Great Garlands Farm, with two level platforms beside the sea wall (OA46 and 161).

4.8.14 A second creek is shown on Chapman and André's map of 1771, immediately to the west of Carter's Creek, which may also have been utilised in the medieval period. The map shows several buildings in the area of Broadhope Farm (OA41, no longer extant) with a road leading down to the head of the creek. Air photographs (Ref 21) and geophysical survey results (Ref 56) show a series of enclosures and possible trackways and other features at this location (OA164), which appear to represent a deserted settlement, occupying the terrace gravel to the west of Broadhope Farm (Figure 2). While the morphology of some of the cropmarks in this area suggests a late prehistoric or Roman date (Ref 21), the Tithe Award Map (1840), names one of the fields at this location as 'Mill Field', suggesting the site of a windmill. It is quite likely that the Broadhope Farm shown on the 18th/ 19th century maps is a remnant of a substantially larger medieval / post-medieval settlement. The same can be said for Great Garlands/ old Garlands.

4.8.15 Archaeological evidence for medieval activity along the foreshore to the south-east of Broadhope Farm comes from the LG excavations at Stanford Wharf Nature Reserve (Figure 2). A series of ditches containing medieval pottery were found in the extreme north-east corner of the site (Ref 20). The pottery from this site also ranged in date from c AD1200-1600. It is worth noting in this context that the Tithe Award Map (1840) shows that the north-eastern field in the Stanford Wharf Nature Reserve site (called 10 acres in 1840) belonged to Broadhope Farm, while the rest of the site fell within the marshlands of Cabborn's Manor.

4.8.16 It is probably no coincidence that the end date for these foreshore sites coincides broadly with the documented onset of large scale, systematic land reclamation in the early 17th century. The construction of sea walls might well have rendered the wharves stranded behind them unusable, as well as radically altering the pattern of land-use in the marshes.

4.9 Post-medieval period (AD1550-present)

The floodplain

4.9.1 In the 16th and 17th centuries there was a widespread drive to reclaim areas of Essex marshland from the sea, the main motivation being to create valuable pasturage for sheep. Two commissions were ordered by Charles I (9th, 1633-4 and 13th, 1637-8) to 'find out what lots had been taken in and concealed from the King'. The Jury stated that 1500 acres, comprising 'Fobbing Level Marshes', had been 'inned' ten years previously (ie in 1623). This is likely to have included much of the marshland within the route study area. In 1622 the marshland of Canvey Island to the east was embanked and reclaimed by the Dutchman Vermuyden, and it is probable that the marshes around Fobbing were enclosed at the same time by the Dutch engineers (Ref 51, 37 and Ref 42, 18). Sparkes, in his history of Corringham marshes, refers to maps at the Essex Record Office, apparently dated to 1621 and 1675 which show the marshes around Fobbing as enclosed by the 'Dutch Wall' (Ref 51, p.37; Ref).

4.9.2 Marshland reclamation would have followed the establishment of an effective sea wall, in the form of the construction of channels around parcels of land in order to drain the land within each parcel. It is possible that the material excavated from the channels was used for banks around the edges of the fields for further protection. The purpose of reclamation of 'waste' (marginal land) would have been primarily economic, providing good-quality grazing for livestock and, eventually, after much drainage, fertile land for crops.

4.9.3 Reclamation is likely to have improved the general living environment of those people living near the edge of the marshes. Young's book on the County of Essex describes the marshlands as being affected by 'thick and stinking fogs, which are often productive of *quarten agues* (probably malaria)' (Young *quoted in* Ref 51, 15). The author Daniel Defoe, who owned a tile factory at Tilbury, described in 1722 the high death rate from 'ague', in particular amongst new wives who moved to the marshes from 'upland' parishes.

4.9.4 Those areas of marshland that were not reclaimed would have continued to be exploited for a variety of purposes and the importance of coastal trading, fish and shellfish in the medieval (and post-medieval) period is well known (Ref 40, 18). Fishing and the use of boats in the creeks within the marsh may have led to the preserved remains of sunken or abandoned boats.

4.9.5 The earliest map of the route study corridor examined as part of this assessment was Chapman and André's map of Essex dated 1771. The map differentiates between the intertidal mudflats and the marshland area, and shows a linear feature along the edge of the marsh (and along almost the whole length of the Essex coast), which may be either a natural scarp slope down to the river edge/mudflats, or an schematic representation of the embanked coastline built to protect the marshland from the rising sea level and further flooding. Within the marsh area, the 1771 map shows an enclosed settlement of three buildings named *Buttons Farm* (OA95) and an enclosed area of two buildings named *Island Mill* at the very edge of the marsh (OA216). The name of the latter suggests a raised 'island' in the marsh, which might indicate that this part of the marsh had not been fully reclaimed and was still prone to flooding.

4.9.6 The OS 1" map of 1805 shows what appear to be roads crossing the centre of the marsh and skirting the edge of the marsh. Examination of the OS 1st edition map (surveyed 1863) shows that these 'roads' are actually raised banks. The banks are likely to have served as sea walls and as raised trackways.

4.9.7 The 1805 map marks '*Oil Mill Farm'* within the marsh but does not clearly show the location of buildings; it is likely that Oil Mill Farm was constructed on the site of *Island Mill* or that the farm had changed name (see para 8.2.79).

4.9.8 The Corringham Parish Plan dated to 1818 is the earliest map showing the individual parcels of reclaimed marshland in the parish of Corringham. It is almost certain that the other marshland areas in Stanford-le-Hope, Fobbing and Mucking had also been reclaimed in a similar way by this date. The Tithe Maps for each parish (1839-40) cover the whole of the marshland area and show the whole marshland as reclaimed parcels of land.

4.9.9 The 1818 map and the Tithe maps (1839-40) show that the parcels of reclaimed land are all fairly uniform in size (if somewhat irregularly shaped), which supports the documentary evidence that the marshland was reclaimed in a single main episode in the early 17th century.

4.9.10 The OS 1st edition 6" map (surveyed 1863) shows several new developments within the reclaimed marsh. These include the appearance of the extant railway track along the southern edge of the marsh and several new buildings. Most of these buildings are no longer extant, although remains of building footings (of limited archaeological interest) may survive below ground. The map show the earthwork banks of the sea walls first shown in 1805 and two non-extant creeks in the eastern half of the area of proposed development, Rugward Fleet and Oilmill Fleet. The developments shown on this map and on later OS maps are discussed in the section on Shell Haven Industrial Development below.

The gravel terrace

4.9.11 The pattern of settlement in the post-medieval period is likely to have remained largely unchanged, with the addition of a number of homesteads and farms and the growth of Corringham and Stanford le Hope. The main changes in this period would have taken place on the floodplain.

4.9.12 The 1771 map shows a number of isolated farms / homesteads on the terrace, located at the side of the road. Figure 2 shows the location of these sites, not all of which are still extant. These appear to include Oak Farm (OA60) and Old Hall (OA161). The map appears to omit some settlements - as Old Garlands Farm was certainly occupied in the late 18th century according to the estate records. Cabborn's Manor house is shown, but not named.

4.9.13 The Ordnance Survey (OS) 1" map of 1805 (Figure 4) is small-scale and therefore representational, but shows buildings. Little appears to have changed on the gravel terrace from the map of 1771 (Figure 3).

4.9.14 The Corringham Parish Map of 1818 and the Tithe Maps (1839-40) show the area of proposed development in detail, with individual buildings and field boundaries. Buildings are shown at Broadhope (no longer extant) and Great Garlands. The OS 1st edition 6" map (surveyed 1863) (Figure 5) and subsequent OS maps dated 1898 (Figure 6), 1924 (Figure 7), 1938, 1960, 1968 and 1976 show little change.

5 SHELL HAVEN INDUSTRIAL DEVELOPMENT

5.1 Pre-19th-century industry

5.1.1 Although the former marshes was heavily developed and dominated by the oil industry during the 20th century, the area was slow to industrialise with almost no large-scale industrial development prior to the second half of the 19th century.

This was despite the location providing the potential for deep-water wharfage on the Thames and was largely due to its marshy topography and relative isolation, a factor which ironically was one of the main attractions to the oil and explosives companies in the late 19th and early 20th centuries.

5.1.2 The earliest hints at small-scale industry within the route study area is suggested by the name of Oil Mill Farm (OA216), which is located on the edge of the adjacent Oil Mill Fleet. The farm and watercourse are first shown on Chapman and André's map of 1771 named 'Island Mill' (Figure 3). A sale catalogue dated 1789 included an entry for a freehold marsh farm called the Oil Mill (Shell Magazine Vol 31). The OS 1" map of 1805 (Figure 4) marks 'Oil Mill Farm' but does not clearly mark the location of the buildings. The OS 1st edition map (surveyed 1863) marks the farm clearly beside Oil Mill Fleet. The name is believed to refer to the crushing of locally-grown flax to produce linseed oil. The process involved retting the flax which produced a strong, unpleasant stench, which presumably explains the need to site the farm in this isolated location.

5.2 Early railway proposals

5.2.1 Among the first proposals for the industrial development of the area was an early scheme for a railway from London (via a link with the Eastern Counties Railway at Romford) to Shell Haven in order to exploit the suitability of Shell Haven for deepwater wharfage referred to above. The intention was to construct a large tide dock (1000 ft by 800 ft) for steam boats and a pier at Shell Haven and to supply the London market with coal and fish. Plans were prepared in 1835 and in the following year an Act of Parliament was obtained for The Thames Haven Dock and Railway Company.

5.2.2 It is useful to note the introduction of the name Thames Haven in the Company's name even though the area had previously been known as Shell Haven. The company clearly felt that a name emphasising the location of the rail terminal on the Thames would be more profitable than the less informative Shell Haven. The name Thames Haven was commonly used for the rest of the 19th century but some reversion to the name Shell Haven occurred in the 20th century due to the association with the Shell Oil Company.

5.2.3 The proposed route lay immediately to the north of the Thames (falling within the study area at the eastern and western ends of the pipeline route). The dock was to be located immediately to the west of Shell Haven Creek, to the south-east of the proposed GEC power station. Several versions of the scheme were developed and there survives a bird's eye view from 1835 showing a large rectangular dock lined by buildings and filled with ships. Among the buildings around the pool and in a separate group of structures to the other side of the railway are *Coal Stores, Warehouses, Hotel*, and *Custom House* (Ref 43).

5.2.4 In 1838 works were started on the large dock and two rows of cottages were built at the site for the workmen due to the isolation of the site and the lack of local accommodation (OA102). The cottages are shown on the first edition (1863) and second edition (1895) OS maps but were demolished in the early 20th century. The construction works on the dock however were halted in 1839 by land possession problems and no further work was undertaken for the next eight years. The company survived and in 1847 new money was raised and works recommenced on both the railway and dock. The resumption proved short-lived and construction works stopped again in 1848. They restarted in 1854 and this time continued until the railway opened in 1855 although the dock remained unfinished (Ref 43).

5.2.5 The railway (OA213) is first shown on the first edition OS map (surveyed 1863) extending east - west along the Thames foreshore and curving down to a railway station and pier at Shell Haven. The station (OA200) was timber-built and consisted of a hip-roofed, single storey terminus abutted by a train shed roof over a concourse and platforms (Ref 43). Adjacent to the east siding were a set of cattle pens and a small open air cattle pound (detailed below). There was a single pier with no pontoon and the outline of a large L-shaped dock (OA201) is shown to the north-west of the station labelled *Dock (Unfinished).* A short distance to the west of the dock were the labourers cottages built in 1838 and the Dock House pub added subsequently. (For a fuller description of the station and associated structures see *The Thames Haven Railway* by Peter Kay, 1999, Ref 43)

5.2.6 The railway is labelled on the OS map as the Thames Haven Branch of the London, Tilbury and Southend Railway and an express train is known to have carried passengers daily from Fenchurch Street Station to Thames Haven where they could board paddle boats to Margate. See below for an assessment of what survives of station and cattle handling facilities.

5.3 Live animal imports

5.3.1 Other than carrying passengers to paddle steamers the principal function of the Thames Haven Railway in its early decades was the inland transport of live cattle which had been shipped into Thames Haven and off loaded at the station.

5.3.2 It is reported that due to the reclaimed marshland in the vicinity of Shell Haven being ideal for cattle fattening the importation of beasts from the continent to supply the London market had been undertaken from the 18th century (Shell Magazine Vol 31 1951). The extent of this early trade is not known and although cattle pens were incorporated into the original 1855 railway station the trade did not develop on a large scale until the mid-1860s. Between 1864 and 1866 there were protracted attempts to establish a cattle importation facility at Thames Haven and this culminated in the establishment in 1866 of The Thames Haven Company and the construction of a new pier, steam cranes, new cattle pens and other buildings (OA202).

5.3.3 Trade was initially slow due to the great cattle plague of 1865 and due to uncertainty over the government's policy towards it but once this had passed and once regulations had been imposed requiring livestock imports to be through specified ports, particularly those with rail links, Thames Haven prospered. Trade was particularly good from 1867-76 during which period about a third of the total UK livestock imports came through Thames Haven.

5.3.4 The facilities were substantially enlarged in 1876/7 but this was shortly before a dramatic collapse of the trade at Thames Haven caused by several outbreaks of disease which prompted the government to move towards a policy of slaughtering animals on arrival in Britain. Thames Haven had no slaughtering facilities and as it was not felt that London butchers would be willing to travel to such an isolated location as Thames Haven it was decided not to construct one. Trade at Thames Haven suffered and the Thames Haven Company was wound up in 1884 but the trade continued to be operated by the railway company themselves albeit at lower levels than between 1867-76. Indeed substantial investment at the plant was made in 1889 in order to benefit from the lifting of restrictions on imports of live Dutch cattle but this proved wasted when disease reoccurred and the restrictions were reimposed. The importation of North American and Canadian animals continued but when there was another outbreak of disease in Canadian cattle their slaughter was required on arrival and Thames Haven was left with no trade. The

cattle importing facilities closed permanently in 1895 although very limited importation of horses continued and the occasional ship continued to dock carrying various goods and perishables.

5.3.5 By 1905 the wharf, which was hardly used, was in need of urgent repairs but no work appears to have been undertaken and in 1909 the pier was hit by the Tyser Line steamer Nerehana and 'seriously damaged'. The pier appears to have been officially closed in 1913.

5.3.6 As referred to above, the first edition OS plan (surveyed 1863) shows some small cattle pens but the second edition (surveyed 1895, published 1898) is the first map to show the much larger cattle-handling facilities and enlarged station just before the imposition of the ban on live animal importation. The cattle facilities were all to the east to the station and incorporated a very large pen for loading onto trains immediately to the east of the station, uncovered pens to the north of this which follow the curve of the rail lines, a pair of large covered cattle lairs to the east and further uncovered lairs. The station itself appears relatively little altered from the previous map but the small original pier has been incorporated into a much larger east-west structure with three separate links to the wharf. Other than the original pier link to the main station, two other bridges link with the cattle loading pens and the cattle lairs. Rail tracks extend along the large jetty. The map shows that by the mid-1890s a river wall had been constructed within the Thames Haven area (mostly outside the study area) and a large embankment had created a raised platform between the station and the Dock House pub. It is apparent that by this stage the plans for the dock had been abandoned as this platform partially infilled the unfinished dock shown on the first edition map and a large irregularly-shaped excavated area is shown behind the platform from which, presumably, the earth for the platform was excavated.

5.3.7 The pier is shown (in ruins) on the 1924 edition map (surveyed in 1919). This map shows the other cattle importation facilities largely intact but clearly no longer operational. The platform roof had been lost and the Dock House pub and cottages at the west end of the 1890s river wall (or embankment) had been demolished, and the Dock House moved further north. Most of the structures had been lost by the 1938 OS map (surveyed 1938) but one cattle pen remained together with the three ruined piers and the station building. The remaining elements of the original Thames Haven station, wharf and cattle-importation facilities were all lost in the mid-1950s when the original station building, the 1855 staff houses, the cattle pens loading bank, cattle shed and stationmaster's house were all demolished (Ref 43,34).

5.3.8 Very little evidence now survives of the railway station, goods yard and livestock-handling facilities (which lies 200m outside the study area to the south-east. The site of the terminus, part of the platforms and the southern end of the covered lairs have been built over by the river wall embankment and adjacent road. The tracks now terminate a short distance inland from their original terminus and there appears to be no evidence surviving of the pier.

5.3.9 The original line of the railway remains in situ and in occasional use with later further tracks to the east so although the station structures have been lost the area has not been substantially built over and evidence of the former buildings is likely to survive beneath the surface. The clearest surviving feature is a substantial cobble-stone surface immediately to the north of the road and to the east of the former station. This is c. 3 m wide and c. 40 m long although it is largely overgrown and obscured. This was in the location of the former cattle lairs (both covered and uncovered) constructed in the 1860s and almost certainly survives from these. No visible evidence survives of the dock excavation as it was infilled

in the mid-20th century and built over with oil storage tanks (which had been lost prior to the current walk-over survey. Although for most of the second half of the 20th century this area has been a tank farm its most recent use has been a settling lagoon.

5.4 Explosive plants

5.4.1 Further industrialisation of the area occurred in the later 19th century following the Explosives Act of 1875 which made it obligatory to build new explosive works on remote sites such as the area around Shell Haven. The first development was the formation of the Miner's Safety Explosives Company Limited in 1888 and the establishment in 1890 of their works on Curry Marsh (on the edge of the Study area) to produce a mining explosive known as ammonite (OA47). Although the plant is not labelled on the relevant Ordnance Survey maps it is shown on both the 2nd edition map (1898) and the 1924 edition map. Both of these maps show several widely spaced buildings in the western half of Curry Marsh which were not shown on the first edition (1870). The buildings are linked by a small rail track which extends north to a structure adjacent to the main railway line and the layout of the site, particularly two detached buildings with earthwork banks indicative of an explosives plant. At its height the plant is reported to have extended to 28 acres, employing 20 to 30 workers, and for a period the explosives produced had to be transported by sea due to the railway refusing to carry it (Ref 51). The factory closed in 1927 and the site remained vacant until it was incorporated into the Shell Haven refinery site in the 1960s (Ref 43).

5.4.2 There is no conclusive visible evidence of the Miner's Safety Explosives plant remaining on site although from the 20th-century and modern map evidence it appears that most of the area has not been built upon since the closure of the plant and it may be that some evidence of the plant does remain *in situ*. However due to the potential dangers that an old explosives plant may pose to an expanding oil installation it is possible that the site was thoroughly cleared and partially excavated. The area is generally uneven but there are no surviving structures and the earthworks do not appear to relate to the banks shown on the OS maps around the explosive structures.

5.4.3 A further, much larger explosives factory, was established later in the 19th century (in anticipation of war with South Africa) which developed greatly in the early 20th century, to the east of Shell Haven Creek. In 1895 Kynoch & Co purchased Borley Farm, well to the east of the present study area, with the intention of constructing an explosives factory for the manufacture of gun cotton, black and smokeless powder, cordite, nitro-glycerine and cartridges.

5.4.4 Construction is reported to have started in 1897 but it was a long process with the necessity to drag large pieces of equipment across the Corringham marshes. There is no evidence of the plant on the 1898 OS map since it was surveyed in 1893 and revised in 1895. In contrast, the next map of 1924 shows a large complex of buildings immediately to the west of Holehaven Creek which are widely spaced and are connected by a series of tramways. Similar to the smaller explosives plant in Curry Marsh many of the detached buildings are surrounded by earthwork mounds to deflect the blast of explosives. The 1924 map shows the complex after it had closed down and many of the portable buildings removed because, although the plant expanded hugely during World War I to employ 6000 workers at its peak, it was closed in 1919 as part of government cutbacks after the war (Ref 50). Earthworks of the Kynoch factory and Kynochtown have been digitally plotted from air photographs as part of the National Mapping Programme.

5.4.5 Due to the isolated location of the plant and the lack of local housing a small company village was established to the south-west of the Kynoch factory immediately outside the factory gates (also outside the pipeline study area to the east). The first houses were built in 1897 and the village, which was known as Kynochtown, rapidly grew to have 40 houses, a school an institute and a shop (Ref 50). The village is shown on the 1924 OS map c.300 m to the east of the study area. In the 1920s the site of the Kynoch plant was taken over by Cory Brothers Ltd who constructed a large oil refinery (described below) and the village was renamed Coryton. The village was closed in 1969/70 to allow expansion of the refinery.

5.5 Corringham Light Railway

5.5.1 The Kynoch company village would only have been able to house a small proportion of the company's workforce and soon after the establishment of the Kynoch works in the late 1890s, the Corringham Light Railway was opened to transport workers to and from the factory from the villages of Corringham and Fobbing to the north-west (OA210). The railway was opened in 1901 and followed a broadly similar alignment to the pipeline between Thames Haven and the villages of Corringham and Fobbing, for a distance of *c* 3 km (running parallel to the proposed at the eastern end of the route, and crossed by it at one point). In addition a branch was constructed south from the light railway to link with the main line Thames Haven branch of the London, Tilbury and Southend railway. The line is shown and labelled on both the 1924 and 1938 OS maps but the last passengers were carried in 1952 by which time the road links across the marshes had improved and the light railway was little used. The 1960, 1968, and 1976 OS maps each label that section of the line stretching north-west towards Corringham as *Dismantled Railway* while the southern branch to the main line and the eastern section passing out of the study area are shown to have been replaced by new track. This provided a link between the Thames Haven sidings and the Mobil plant (described below).

5.6 Establishment of early oil industry

5.6.1 The industrial development of the route study area in the 20th century is dominated by the immense Shell and Mobil oil refineries but its origins lie in the 19th century. The first imports of oil into the UK took place in the 1860s and in 1871 an early attempt to regulate the trade was attempted when The Petroleum Act was passed which empowered the Thames Conservancy to prohibit the passage of large petroleum vessels above Mucking Lighthouse at Thames Haven (Ref 43). Thus Thames Haven became the closest that ships transporting oil could get to London and became the natural place for an oil wharf. In this early phase the oil imports were largely of kerosene transported by sailing ship each carrying about 5000 wooden casks (*Shell Magazine* Vol 31, 1951). The ships moored at buoys in the river and the barrels were off-loaded into small lighters to be transported to the wharf.

5.6.2 The industry was still very much in its infancy and it was five years after the Petroleum Act before the first permanent oil installation was established within the route study area c.800 m west of Thames Haven Station adjacent to Shelly Bay (OA204). This was a warehouse and large pier projecting into the river constructed in 1876 by the Petroleum Storage Company (PSC). The pier allowed the barrels to be off-loaded directly to land rather than via lighters. The barrels were stored in the warehouse and subsequently transported away via the rail

sidings constructed in 1878 linking the oil installation with the Thames Haven branch railway (Ref 43). Although most of the oil was dispatched by rail there is also reported to have been a self-propelled platform-type trolley along the sea wall by which oil could be carried to Stanford-le-Hope (Shell Magazine Vol 31).

5.6.3 Following the importation of the first consignment of American oil in 1880 the PSC is reported to have built a range of concrete oil stores at Thames Haven (Shell Magazine Vol 31, 1951). The first tankers were not introduced until 1892 with vessels which took a week to unload (Shell Magazine, Vol 31).

5.6.4 Although the trade was successful and the plant was expanding the company encountered financial difficulties and the PSC went into liquidation in 1881. In the following year a new company, the London & Thames Haven Wharfage Co was registered but never actually formed and it appears that the concern was continued through the 1880s by Edward Hunter who was behind the original 1876 establishment. In 1894 a new company, *The London & Thames Haven Petroleum Wharf Ltd*, was formed which ran the site before being wound up in 1898 and replaced by another new company *The London & Thames Haven Oil Wharves Ltd* (LATHOL) (Ref 51 and Ref 43).

5.6.5 The first map to show the oil installation is the 2nd edition OS map of 1898 (surveyed 1893, revised 1895). The map shows the pier with a crane at the end and a simple set of rail tracks along its length. Immediately adjacent to where the pier adjoins the river wall is a large *(c.* 100 m long) rectangular building which was presumably the main warehouse. To the north of this were several further substantial buildings and 14 circular oil tanks of various sizes. Three sections of track forming the rail sidings are shown linking each part of the installation to the main rail lines.

5.6.6 Very little now survives on site of the original 19th-century oil storage installation although it appears that much of it did survive until the later 20th century. The 1960 map shows relatively little change from the early 20th-century maps; the 1968 map shows the main warehouse surviving together with the sidings and the 1976 map shows the rail sidings and a smaller building on the site of the original warehouse. The site has now been cleared of all structures and the sidings have gone although there survives some evidence of them where they crossed the road.

5.6.7 By the turn of the century the installation had expanded as far as was practicable within its original borders and substantial expansion was only made possible by the purchase in 1902 of the land to the east of the original site, between it and the station, from the London & North Western Railway (OA203 / 206). It was then possible to expand the handling capacity of the site based largely on the site having a monopoly on the London oil trade. Between 1906 and 1914 every ton of low test petroleum which entered the Port of London is reported to have landed here (Sparkes) but the site also developed to handle many other grades of oil and spirit imports. By the outbreak of the First World War there is reported to have existed at the LATHOL plant an extensive network of pipe lines, exchange houses and pump houses handling 400,000 tons of refined products annually (Shell Magazine Vol 31).

5.6.8 The second oil installation to be established at Thames Haven was that of the European Petroleum Company (EPC) on land immediately to the west of the LATHOL site (OA205). The EPC purchased the site in 1895/6 and started the construction of a refinery although this appears not to have been completed and the company folded in 1900 to be replaced by another company of the same name (Ref 43). In 1911 the second company was dissolved and its Shell Haven site was taken over by LATHOL to allow the westward expansion of its installation.

The LATHOL site was further expanded by the construction of a small refinery (OA208) in 1914 on land immediately to the north of the railway line beneath a loop in the Rugward Fleet, and by the purchase of a large area of land to the north of the Rugward Fleet to allow for future expansion.

5.6.9 The OS edition of 1922 map (surveyed 1915) shows the development of the original LATHOL plant and the expansion of the site into adjacent areas. The expansion is largely hidden on the 6":1 mile map, due to this map not showing oil storage tanks but the 25":1 mile map does show tanks and provides a good indication of the plant. The original site is shown with 32 tanks located between the original 1876 buildings and rail sidings while the former EPC plant is shown with 14 tanks, a water tower, a pier, a connecting siding and a small row of terraced houses which were presumably provided for employees due to the relative isolation of the plant from suitable local settlements. The site to the east (OA203) purchased in 1902 is shown with a pier and 20 tanks set on a large raised bank. The refinery is shown immediately to the north of the railway line and to the north of this are the two large Reedham tank farms set on raised banks with 17 tanks to the west (OA211) and 21 tanks to the east (OA212).

5.6.10 The other major oil installation which developed at Thames Haven adjacent to the LATHOL plant was to the north-east of the railway station between it and Shell Haven Creek on 86 acres of land purchased in 1911 from Oil Mill Farm by the Anglo-Saxon Petroleum Company (ASPC) (OA207). The ASPC was an operating company set up in 1907 by the Shell/Royal Dutch group and hereafter the plant is referred to as the Shell site. The new facility included a tank farm, piers and a refinery which came on stream in 1916. Referring to this the Earl of Carrick, Chairman of the Motor Owners Petrol Combine, in 1914 spoke of "the building of a refinery at Thames Haven capable of yielding 3,000,000 gallons per annum" (Shell Magazine Vol 31).

5.6.11 The Shell refinery was situated at the extreme eastern end of the route study area). The first map to show the refinery is the OS map surveyed in 1915 which shows the site consisting of two piers (both with cranes), 13 oil tanks, a private rail siding, a reservoir and various other structures. Among the plant there is known to have been a Trumble Continuous Topping Plant and a converter unit both of which were operating in 1916 (Shell Magazine Vol 31). This site has now been abandoned and none of the original structures remain standing.

5.7 Development of oil industry in the inter-War period

5.7.1 In the 1920s and early 1930s the oil facilities at Thames Haven, particularly the LATHOL plant, developed gradually and primarily in the area of storage rather than processing. Indeed up to the 1950s the majority of oil processing in the Britain was further refining ('topping') of oil which had undergone its primary refining overseas (Ref 43). The most important product passing through the LATHOL plant in this period was previously refined motor spirit destined for the London market. As referred to above the LATHOL land had expanded in c.1915 when a large area of land to the north of the railway line was purchased but other than the Rugward east and west tanks constructed during the First World War it does not appear that LATHOL significantly expanded its plant into this area in the inter-war period (Ref 43).

5.7.2 The next map to show the LATHOL plant is the OS edition of 1938 (revised 1938) but unfortunately neither the 6" or the 25" maps show oil tanks so the maps do not give a fully accurate impression of the largely-storage LATHOL plant although they do show the raised platforms on which the tank farms stood. The map shows

relatively little development on the original LATHOL site with the 1876 warehouse, two piers and railway sidings still intact. Several new small structures are shown at the north-eastern corner of the site. The area to the east shows no significant change from the previous map (1915) and the former EPC site to the west shows only minor alterations. The most significant development is shown north of the railway line and north of the two Rugward tank farms. A large cluster of new structures is shown in this area immediately to the west of the railway line but most of the area north of the Rugward tank farms is shown as remaining as undeveloped marsh land.

5.7.3 The Shell refinery at the eastern end of the route study area (and extending outside it) appears to have developed more substantially in the inter-war period. The early refinery had concentrated principally on producing fuel oil for the Navy but after the end of the war the main production was of bitumen refined from crude oils imported from South America (Shell Magazine, Vol 31). Production in this period also included printing ink, luboils, asphalts and Mexphalte (Ref 43). Several steam stills, spirit agitator houses and coal fired re-run stills are known to have been constructed in 1920 and 1921 (Shell Magazine, Vol 31) and in 1936 a large new dewaxing and distillation plant was constructed on reclaimed land for the production of lubricating oils for motor cars and aircraft. Further expansion in the late 1930s included the construction of a rectiflow and contact plant (part of the dewaxing and distillation unit) and plant for the manufacture of horticultural sprays and insecticides (Shell Magazine Vol 31).

5.7.4 Some early 'snap-shots' of life at the plant are provided by *The Pipeline* which was the journal of the whole Shell/Royal Dutch group of companies and began publication in 1921. (This was preceded by a war-time publication called the *St Helen's Court Bulletin*). Although *The Pipeline* tends to concentrate on the social life of the plant rather than documenting its expansion and operations, it does refer to a tank fire in 1921 which destroyed a 50 ft diameter tank with 800 tons of heavy spirit. It is also interesting to note the frequent references made to the isolation felt by the plant's employees due to the location of the Shell Haven site.

5.7.5 The expansion of the Shell plant is apparent on the 1938 OS map although as already mentioned, this does not show oil storage tanks. The site is shown to have substantially filled-out with new buildings although most of these are outside the study area. The inter-tidal area immediately south of Shell Haven Creek, which is not affected by the pipeline, is labelled 'saltings' on the 1915 map. It is shown to have been reclaimed (for the dewaxing plant referred to above) incorporating a new river wall adjacent to the creek.

5.7.6 Another oil facility was developed between the wars, outside the route study area, on the site of the Kynoch explosives plant which had closed in 1919 (detailed above). The Cardiff-based firm of Cory Brothers Ltd purchased the site in 1923 and constructed a refinery and oil storage plant (OA209). Refining on the site was suspended in 1938 due to supply problems relating to the Munich crisis and throughout the 2nd World War the site was used as a large storage depot.

5.8 Post-World War II expansion of oil facilities

5.8.1 During the Second World War and particularly in the period following it the oil plants in the Shell Haven area expanded greatly following the trend towards primary refining being undertaken in the country of consumption rather than importing ready-refined products.

5.8.2 Increased war-time demand led to the construction of a new unit at the Shell plant for the production of specialised grades of cutback bitumen and another for high-

grade paraffin waxes. This was within the area of the original Shell plant to the east of the Thames Haven Station but the main post-war expansion of the Shell plant was on a large, previously marshy area to the north-west of the LATHOL plant and within the current development area. The land was purchased in 1947 from LATHOL with an agreement that Shell would not use the land for an oil storage installation. Thus an agreement was reached for Shell to use LATHOL's storage facilities and this is one indication of what appears to have been a gradually closer co-operation between the two plants which culminated in 1969 when Shell took over the LATHOL plant and piers.

5.8.3 A number of new units were constructed on this land (the west site) in the early 1950s the most important of which was the new MEC (Middle East Crude) refinery which came on stream in 1950 and produced various petroleum products (Shell Magazine Vol 30). Among other facilities opened in the early 1950s were a cooling-water pump house taking water from the Thames, a distillation plant, a boiler plant and a doctor treater (Shell Magazine Vol 30).

5.8.4 Later in the decade a second crude distiller unit was added together with a fertiliser complex on the west site (Ref 43) and in the early 1960s an isopentane plant was constructed (Shell Magazine, Vol 41). A new bitumen plant was constructed at the west end of the site to replace the previous bitumen plant at the east end. The new plant came on stream in 1981 (Shell World, June/July 1981). Many other alterations to the refinery plant were made in the second half of the century but it has not been attempted to specifically detail them all here.

5.8.5 The development and enlargement of the post-war Shell refinery is well shown on the OS maps of 1960, 1968 and 1976 and on a Shell site plan originally drawn in 1961 but with various additions up to 1976. The most dramatic change is apparent when comparing the 1960 OS map with the previous pre-war map (1938). Between these years the refinery expanded from the relatively localised site towards the eastern end of the study area to something close to the modern refinery site, which filled much of the former Thames floodplain. The pipeline route forms an arc around the northern edge of the refinery, which extended as far as the A1014 Manorway. The western half of the new site, extending as far west as the former Miner's Safety Explosives plant, is shown covered on the 1960 map by the new refinery while the eastern half of the site, extending up to the already existing LATHOL plant is covered by large tank farms. The 1968 and 1976 maps show further expansion of the Shell site to the west (of the refinery and processing plant) and northwards (of the tankage).

5.8.6 The Cory Bros site (outside the route study area) which had been used for storage during the war was purchased by the Vacuum Oil Company (renamed Mobil in 1956) in 1950 with the intention of constructing a large new refinery. This came on stream in 1953 and the site continued to be developed in the second half of the century.

5.8.7 Although the 20th-century industrial development within the route study area is totally dominated by the oil industry one other plant within the route study area which survived for a period was an ammonium nitrate plant operated by Fisons. This opened in 1959 and was located on the south side of the Thames Haven branch line close to the junction between the railway and the Wharf Road (south of Stanford-le-Hope). The plant closed around 1970 (Ref 43).

5.9 World War II (1939-45)

5.9.1 The route study area contains a considerable number of sites constructed during the Second World War (WWII), clearly indicating that an attempt had been made

to protect the north bank of the river from attack. The sites take the form of pillboxes (OA69 and 72, neither of which are extant), road blocks, mortar emplacements, gun emplacements and observation posts. None of the above features survive within the route study area, and none are expected to be affected by groundworks.

5.9.2 Within the area of proposed development itself, air photographs dating to the 1940s show an extensive spread of anti-glider ditches, typically cross-shaped ditches bordered by concrete stumps, across the whole of the marshland area (OA55 and 104), some of which may be directly affected by the pipeline. The ditches would have broken up the flat ground surface making an enemy airborne landing impossible. Most of them lie beneath the Shellhaven oil refinery and have been destroyed; in the areas outside the refinery they appear to have been subsequently infilled. The NMP (updated by ECC, May 2011, Ref 21) digitally plotted the positions of the anti-glider ditches and they are shown on Figure 2. No trace of these features was found during trenching in the LG Northern Triangle site, although the trenching coverage was limited to a series of ecology pond locations (Ref 16).

5.9.3 Air photographs show several bomb craters within the LG Northern Triangle site, which is crossed by the pipeline route (OA94). None of them are directly affected by proposed groundworks.

6 ARCHAEOLOGICAL POTENTIAL

6.1 Zone 1 - Former tidal flats

Geomorphology

6.1.1 The eastern section of the pipeline route, from the proposed energy centre to south-east of Corringham, falls within Zone 1. The evolution of the tidal flats is complex. At the end of the Devensian and during the early Holocene the Thames floodplain is liable to have been an extensive gravel braidplain. Recent modeling (Bates and Bates 2009) has shown the development area began to accumulate inter-tidal sediments from the late Mesolithic (c. 6500 BC), from both marine and riverine influences, the channel network probably becoming more constrained and less braided as a result. The process of sedimentation continued throughout the Holocene, producing the current depth of alluvium. At the eastern end of the route in the vicinity of the proposed energy centre these deposits can be in excess of 12m thick. They become progressively shallower closer to the terrace edge. Construction of a sea wall, probably in the early 17th century (See 4.9.1), halted marine influence into the alluvial floodplain, and the vertical accretion of the sediment body stopped. The top of the alluvial sequence has subsequently undergone soil maturation and stabilisation, coupled with intensive draining and agricultural improvement (Ref 17).

Archaeological potential

6.1.2 There is significant potential for early Mesolithic land-surfaces (pre-dating inundation of the floodplain c. 6500 BC) to be preserved underneath the later Holocene alluvium. However any such remains will for the most part be well below the maximum depth of impact of the pipeline (estimated at 3m) except potentially close the terrace edge (See Zone 1 and 3 interface, below).

6.1.3 As this zone is characterised by former marshland and inter-tidal deposits, the potential for archaeology being found within the upper alluvium is generally very

low, although the possibility exists for marine and inter-tidal features such as boats and fish-traps, which can be exceptionally well-preserved in waterlogged conditions, and could occur at any depth within the Holocene alluvium. The vicinity of substantial watercourses, such as Mucking Creek and Carter's Creek are the most likely location for such finds, although the course of the inter-tidal creeks may have shifted substantially through time. Because of the amount of reworking of deposits in this dynamic environment, the potential for archaeological remains is arguably lower than in more constrained alluvial channels, such as Zone 2 (Mucking Creek/ Hassenbrook). There are currently no non-intrusive methods suitable for detecting ephemeral organic remains buried at depth within alluvial deposits.

6.1.4 The LG Northern Triangle ecological compensation site, which overlaps with the route study area (Figure 1) has been investigated previously using air photographs, Lidar data, cartographic sources, walkover survey and trial trenching. It contains evidence for medieval and later sea defences, land reclamation and agricultural improvement.

6.1.5 WWII anti-glider ditches (OA55) were placed across the site, but have subsequently been infilled and are only evident as crop-marks. The Shell Haven oil storage facilities were a strategic target during World War II, and this is reflected in defensive features and bomb craters of this period within the site and adjacent areas. The HER records earthworks of WWII bomb craters on the eastern side of Manorway Fleet (OA94).

6.1.6 Identified extensive landscape features that may be directly affected include old sea banks and traces of post-medieval 'stetch' cultivation (similar to 'ridge-and-furrow' but generally formed by mechanised ploughing from the 19th century).

6.2 Zones 1 / 3 - Terrace / floodplain interface

Geomorphology

6.2.1 The pipeline route between Corringham and Great Garlands Farm broadly follows the interface between the tidal flats (Zone 1) and the terrace edge (Zone 3). In 2009, as part of the LG Access Road evaluation, an electrical resistivity survey was successfully used to model the depth of the geological sequence at the transition between the terrace and tidal flat deposits in this section of the pipeline route. The resistivity profile clearly shows a rapid deepening of deposits across the interface zone, which suggests the presence of an in-filled ancient channel at the floodplain edge, which has cut laterally into the terrace deposits. This reduces the likelihood of encountering earlier prehistoric remains close to the terrace edge. This channel has subsequently infilled with fine-grained alluvial sediments. The channel may be an earlier alignment of 'Carter's Creek' (Figure 2, OS 1st Edition).

6.2.2 However the potential for later archaeological remains to be preserved in this zone is high, due to:

6.2.3 the presence of waterlogged alluvial sequences, forming anaerobic environments likely to preserve organic materials, such as timber, leather, etc.

6.2.4 the presence of a formerly navigable Creek (Carter's Creek), associated with a probable 13th-16th century wharf site, with high potential to contain wharf structures, boats, boat-building infrastructure, etc.

Archaeological potential

6.2.5 The excavated evidence for prehistoric and Roman archaeology from the LG Access Road trial trenches in this zone is surprisingly slight. A small group of mid-

late Iron Age pottery, possibly from a single vessel, was found in an alluvial layer at the very edge of the terrace in trial trench 28 (Ref 12).

6.2.6 The Coryton Power Station Gas Pipeline in this section was cut through shallow alluvial deposits overlying Head, which resulted in the discovery of well-preserved medieval archaeological deposits near Great Garlands Farm in 1999 (OA57). The LG Access Road evaluation also identified a concentration of medieval features and artefacts, at the edge of the gravel terrace, c. 400m to the south of Great Garlands Farm. Taken together, the two sites suggest the presence of a linear creekside settlement, potentially including a range of domestic, trading and maritime activities, extending from the Manor Way track, south-westwards along the edge of the gravel terrace, for a distance of perhaps 600m. The activity appears to be focused around the head of 'Carter's Creek', which empties into the River Thames c. 500m to the south-east' (Figure 2, as named on the OS map of 1873). The pottery from both sites falls into two chronological groups, the earlier material dating from the 12th-14th century and the later dating from the 15th-16th centuries. A third medieval site, also dating broadly from the 12th-16th centuries, was found in the north-east corner of LG Stanford Wharf Nature Reserve, and may be another wharf site connected with the historic Broadhope Farm.

6.2.7 The new pipeline route is located c 100m north of the existing pipeline, in order to avoid the known archaeology (OA57). There is no indication from geophysical survey or cropmarks that the known archaeology extends into the proposed pipeline route. All reasonable efforts have been made to assess the extent and significance of archaeological remains in this zone. Nevertheless, there is a risk that the non-intrusive surveys have not detected the full extent of this site, so the archaeological potential is uncertain.

6.3 Zone 2: Mucking Creek / Hassenbrook crossing

Geomorphology

6.3.1 The pipeline route crosses the Hassenbrook just to the north of Mucking village, at the point where the stream empties into the tidal Mucking Creek. The Hassenbrook, is a relatively small stream that has nevertheless had a substantial influence on the settlement pattern in the Mucking/ Stanford-le-Hope area.

6.3.2 BGS mapping (Figure 2) shows the approximate extent of alluvium within the valley. Mucking Creek forms an incised feature which has cut into and exposed deeper areas of the alluvial sequence. Holocene alluvium may be expected to overlie Pleistocene gravels of the Taplow formation, the latter forming the terrace edge within the valley.

Archaeological potential

6.3.3 In spite of the high archaeological potential, a watching brief by ECC, carried out in 1999 at the eastern end of the existing Coryton Power Station gas pipeline, did not identify any significant archaeology in this area.

6.3.4 The only prehistoric remains in this zone recorded in the HER are Palaeolithic implements including flakes and handaxes, which were found in a gravel pit at Mucking in the late 19th century (OA7). Most areas of near surface gravel are likely to have been quarried away, but any surviving pockets clearly have the potential to contain further Palaeolithic artefacts.

6.3.5 Recent excavations at LG Stanford Wharf Nature Reserve (OA9), uncovered extensive evidence for Roman salt-making and associated food preservation activities, dating from the 1st - 4th centuries AD, at a site on the eastern bank of

Mucking Creek, 1km downstream from the pipeline route, but in a similar topographical context. The Roman salterns were found at the interface between the gravel terrace and the inter-tidal zone, well-preserved beneath shallow, partially waterlogged alluvial sediments. Remains included a piled timber structure, interpreted as a boathouse, remains of salt-making buildings, and complex stratified archaeological deposits infilling the edge of Mucking Creek.

6.3.6 The high archaeological potential of this zone is also indicated by the concentration of archaeological sites and historically recorded settlements on the banks of Mucking Creek, including the village of Mucking on the west bank, and the former site of Cabborn's Manor on the east bank (OA14), both of which are located at the interface between the alluvium and terrace gravel. Both settlements were associated with wharves, situated somewhat downstream. However the location of the wharves could have shifted downstream as a result of silting in Mucking Creek. They may originally have been closer to the medieval settlements. Although the site of Cabborn's manor house (OA14) has been removed by quarrying, there is a strong likelihood of associated features, and potentially earlier archaeology, surviving in localised patches in the vicinity, particularly in alluvial deposit sequences associated with Mucking Creek/ Hassenbrook, and in preserved areas of gravel between the quarry pits. Due to the waterlogged conditions prevailing in alluvial environments, the preservation of organic materials can be exceptional. A wide range of archaeology could potentially be found within surviving areas of alluvial deposits, such as abandoned boats and boat-building infrastructure, wharves, tidal mills, salterns, etc.

6.4 Zones 3 and 4 - Gravel terrace

Geomorphology

6.4.1 The Undifferentiated Head (Zone 3) and River Terrace deposits (Zone 4), are a series of sediment units, formed from c. 200,000 BC onwards. In this report the 'River Terrace deposits' collectively refer to gravels mapped by BGS as 'Taplow Gravel' (within Mucking Creek), and River Terrace 2 and 3 deposits elsewhere (Figure 2). The study area also includes Lynch Hill terrace gravels, which are not directly affected by the pipeline, but have similar archaeological potential. These deposits have a different formation history to the lower floodplain. They have the potential to contain archaeology from the Late Palaeolithic through to the present day, at relatively shallow depths within the sediment profile. During the Holocene, shallow soils have developed above them. Holocene archaeological features (dating from the Mesolithic onwards) would normally be found immediately below the ploughsoil in these zones, cut into the surface of the gravels and Head deposits). The majority of the central and western pipeline route sections fall within Zones 3 and 4, which extend on either side of the Hassenbrook/ Mucking Creek.

Archaeological potential

6.4.2 In theory Zones 3 and 4 have equally high archaeological potential, being comparatively well-drained soils, suitable for arable agriculture, and in close proximity to the terrace edge. However there is a distinct focus of cropmarks, geophysical survey sites and recorded historic settlements in the areas of River Terrace gravels, which suggests that the gravels may have been preferred over the clayey Head deposits for settlement sites in many periods (Figure 2). This suggestion is partly borne out by the results of limited trial trenching along the line of the LG Access Road, although the trenching was too limited in extent to demonstrate the case.

6.4.3 The terraces of the River Thames are extremely rich in archaeological remains, and the general vicinity of the proposed pipeline route is no exception. Most notably, the well-known excavations at Mucking in advance of gravel quarrying in 1965-78, at the western end of the route study area, revealed a complex series of superimposed landscapes, dating from the Neolithic to the Medieval period, with substantial settlements and cemeteries of Bronze Age, Iron Age, Roman and early medieval date, extending over 18 hectares.

6.4.4 Zones 3 and 4 fall into two main sections, separated by the Hassenbrook/ Mucking Creek (Zone 2), considered in turn below:

Zone 3 / 4 (Stanford-le-Hope Section)

6.4.5 Extensive areas of archaeological features can clearly be recognised in the central section of the route study area, in particular in the cropmark data (Figure 2). The geophysical surveys in these areas generally support the cropmark evidence, without adding significant additional data. A wide band of soilmarks and cropmarks crosses the upper part of the terrace, predominantly in areas mapped as River Terrace deposits (gravel) describing a network of ditches, probably settlement and field enclosures, with trackways between them and possible hut circles. The cropmarks are undated, some appear morphologically similar to late prehistoric/ Romano-British rural settlement, but also coincide with areas of medieval/ post-medieval settlement near Broadhope Farm and Old Garlands Farm (Figure 2, OA58 and OA164). They could alternatively be a palimpsest of several periods, as at Mucking.

6.4.6 The evidence from fieldwalking survey on the gravel terrace was generally negative. Most of the cultural material collected was ceramic building material of recent origin. Otherwise a low density background scatter of Palaeolithic to Bronze Age worked and burnt flint was present, within which it is possible to suggest a slightly more significant concentration of worked flint along the floodplain / terrace boundary (Zone 1 / 3). Prehistoric and Roman pottery was also present in small quantities, and a minor concentration of medieval material was found close to Great Garlands Farm (Ref 12).

6.4.7 The LG Access Road trial trenching results, while limited in extent, broadly confirmed the predictions made on the basis of the non-intrusive surveys, although the density of features, and the quantity of artefacts recovered, was perhaps less than expected, particularly in Zone 4 (River Terrace deposits). Archaeological features found in the trial trenches were generally sparsely distributed, and mostly undated. One small group of Iron Age pottery was found in a pit in Trench 12, and a cluster of medieval features was found along the edge of the gravel terrace edge, close to Carter's Creek (Zone 1 / 3). However the LG Access Road route consciously avoids the main cropmark concentrations, so these results cannot be seen as typical of the gravel terrace generally. The trenching broadly supports the impression from the cropmarks that the distribution of archaeological features is closely related to the extent of the River Terrace deposits (Zone 4), and sparsely distributed in areas of Head Deposits (Zone 3), except along the terrace near Carter's Creek, which seems to have acted as a significant settlement focus in the medieval and post-medieval period, regardless of the soil type.

Zone 3 / 4 (Mucking section)

6.4.8 At the Western end of the pipeline route (see Figure 3) the survey coverage is limited. However the archaeological potential in this section is known, from previous archaeological investigations, to be high. Large scale landscape excavations to the north-west of Walton's Farm, Mucking, in advance of gravel

extraction between 1965 and 1978, c 250m west of the western pipeline terminal, revealed extensive and complex multi-period remains, starting in the Neolithic but predominantly of Bronze Age, Iron Age, Romano-British and early medieval date. The site includes the Bronze Age circular enclosure known as Mucking South Ring, extensive Iron Age unenclosed settlement, a series of Roman enclosures and cemeteries that may be the outskirts of a villa complex, and one of the most extensively excavated series of early medieval settlements and cemeteries in the UK (Hamerow 1993). A second major Bronze Age circular enclosure, Mucking North Ring (250), was excavated prior to construction of St.Clere's Golf Club, and lies 300m north-west of the pipeline terminal (Bond 1998).

6.4.9 In addition, a series of Iron Age ditches was identified in 1999 to the west of Mucking Village, during construction of the existing Coryton Power Station gas pipeline (Figure 2, OA1, 241). Surface scatters of Iron Age and Roman pottery have also been found in the same general area (OA242, 243). While most of the gravel areas have been quarried away it is likely that archaeology extending into areas mapped as head deposits (Zone 3) could survive in situ. There is no indication from aerial photographs that the pipeline route in this section has previously been quarried, and the 1999 watching brief results from the existing pipeline suggests that multi-period archaeology is present just beneath the ploughsoil in at least some sections of the route between Mucking Village and the western pipeline terminal. This area is archaeologically highly significant in terms of understanding the relationship between the multi-period archaeological sites at Mucking, and the origins of the present village of Mucking, which is enhanced by the fact that it is one of few remaining unquarried areas.

7 ARCHAEOLOGICAL ASSESSMENT

7.1 Construction impacts

7.1.1 Excavation of the pipeline will consist of the temporary stripping of topsoil from a working area c 10m wide, and the excavation of a pipe trench (estimated depth - 3m). Above-ground infrastructure will be constructed at the pipeline terminals. Road and watercourse crossings will be made using Horizontal Directional Drilling (HDD). The crossing of Mucking Creek will be by HDD at a depth of c 4m - 5m. In addition to the pipeline easement, earthworks of uncertain location and extent could include temporary access roads and works compounds.

7.1.2 The pipe trench itself is expected to be c 1m wide and excavated to a typical depth of c 3m, which has the potential to impact upon significant archaeology. However the pipe trench is very narrow and the magnitude of impact is consequently low throughout the route. The pipeline working easement is considerably wider (c 10m). However it will be stripped of ploughsoil only (to a depth of c 0.3m). The arisings will be stacked alongside the easement, which will be returned to agricultural use following reinstatement. The level to which the easement soil stripping occurs in any of the route sections is critical to the level of exposure of archaeological features and the need for mitigation. If soil coverage is very limited, as is expected in Zones 3 and 4 (the gravel terrace) disturbance to archaeological deposits within the whole easement width is inevitable. If soil coverage is comparatively thick, as is expected in the floodplain (Zones 1 and 2) there is greater potential for preserving archaeological deposits in situ.

7.2 Uncertain impacts

7.2.1 The survey information which is available is such as is reasonably required to assess the environmental effects of the development on the architectural and archaeological heritage and which having regard to current knowledge and methods of assessment the applicant can reasonably be required to compile. However the distribution and significance of archaeological remains is intrinsically unpredictable, and the precise effects of construction impacts will, in some cases remain uncertain until excavation of the pipeline is in progress. Uncertain effects are identified in Table 5 and the assessment text, where applicable.

7.3 Construction effects on archaeology before mitigation

7.3.1 All construction effects to archaeology on this scheme would be permanent.

7.3.2 Visual effects are not usually relevant to buried archaeology. Any archaeological features that include upstanding earthworks, that could have a visual aspect, are considered separately under 'Historic Landscape'.

7.3.3 The effects of construction on known or predicted archaeological remains are considered by zone below.

Zone 1 - Former tidal flats

7.3.4 Almost all of the gazetteer entries in this zone are either undated or known to be modern in date. All are either of low or medium importance. The Gazetteer entries comprise industrial, transport and military features, most of which date from the late 19th century onwards. OA216 is the site of Oilmill Farm, which lies just within the route study area but is not significantly affected. OA203, 206, 208, 211, 212 are all components of the early 20th century oil storage facility at Thames Haven, none of which are directly affected.

7.3.5 Corringham Light Railway, and WW2 bomb craters and anti-glider ditches (OA55 and 94), and areas of 'stetch' cultivation to the north of the A1014 Manor Way, are considered below in the Historic Landscape section.

7.3.6 OA167 is indicated as a possible cropmark ringditch of uncertain date, but in reality is almost certainly of post-medieval or modern date. Although close to the pipeline it is not directly affected. This feature was not recorded in the most recent 2011 cropmark update by ECC. Even if it is a real archaeological feature, given the mid-floodplain location, it cannot be prehistoric in date.

7.3.7 Given the narrow impact of the pipeline, the magnitude of change is low. The potential for significant archaeology to be present in the upper alluvium is also low. Construction effects to known and potential archaeological remains within this zone are therefore considered uncertain, but are likely to be insignificant.

Zone 1 / 3 Terrace/ floodplain interface

7.3.8 Creekside medieval sites to the south-east of Great Garlands Farm. The main focus is expected to include OA46, 57, 166, 180, 363 and 364, but medieval activity appears to be extensive along the former Thames foreshore to the south-east of Great Garlands Farm. These sites together are of uncertain, probably regional (high) importance. The pipeline in this section has been routed so that it passes c 100m to the north of the known archaeology, but there is a risk that features have not been detected using non-intrusive methods, and could be more extensive than expected. The assessment of construction effects before mitigation

is therefore uncertain, but are likely to be minor adverse.

Zones 3 and 4 - Gravel terrace, Stanford-le Hope section

7.3.9 Cropmark sites of uncertain date are present on the gravel terrace, in the vicinity of Great Garlands Farm (OA163) and Broadhope Farm (OA164). The archaeological cropmarks are undated but probably include medieval and post-medieval features, although other elements appear morphologically typical of late prehistoric and Roman rural settlements. The pipeline route avoids the obvious concentrations of cropmarks, and the main foci indicated by geophysical survey. However as discussed above there is a risk that features have not been detected using non-intrusive methods, and could be more extensive than expected.

7.3.10 Within Zones 3 and 4 (Stanford-le-Hope section), the overall magnitude of change is uncertain, but likely to be low, as the pipeline is narrow and avoids the main areas of archaeological cropmarks. The remains predicted in this zone are expected to be extensive and comparatively well-preserved, and therefore of high importance. Construction impacts are uncertain, but pare likely to be minor adverse, before mitigation.

Zone 2 - Mucking Creek / Hassenbrook crossing

7.3.11 The potential for surviving archaeology within the valley of Mucking Creek/ Hassenbrook is uncertain, depending on the extent of survival of intact alluvium and gravel deposits, centred on OA 14, the former site of the medieval Cabborn's Manor. The archaeological potential has been greatly reduced by quarrying. If archaeology survives at all it will be in narrow strips and pockets between quarry pits. Any surviving archaeology is likely to be of no more than medium or low importance, due to the poor state of preservation.

7.3.12 The route in this section will be constructed by HDD, at a depth of c. 4m - 5m, below any surviving archaeological deposits that may be present, so the magnitude of change is very low. The construction effects in this route section are therefore insignificant

Zones 3 and 4 - Gravel terrace, Mucking section

7.3.13 Multi-period, mainly Iron Age features are known to be present in the pipeline route to the west of Mucking Village. Archaeological records in the vicinity include OA1, 241, 242, 243, 244, 286. These remains are of uncertain, probably high importance. Some impact on buried archaeological remains in this section is unavoidable. Iron Age ditches were found within the previous pipeline route, which are certain to extend beyond the pipeline route.

7.3.14 The route in this section has to terminate at the existing gas pipeline terminal, leaving very limited options for re-routing to avoid the known archaeology. Diverting the pipeline would probably create an equal or greater impact than the proposed route, as the archaeology appears to be extensive. The potential for using non-intrusive surveys to clarify the extent of archaeology in this zone is low, as Clay Head deposits are much less susceptible to geophysical survey methods than gravel. No cropmarks are visible in this area, even though archaeological features are known to be present, probably also due to the clay geology. Trial trenching is the only survey method that would reliably determine the extent of archaeology in this route section. However if carried out at a sufficient level to inform alternative route options, trenching would itself create a substantial archaeological impact, that must be balanced against the relatively limited impact from the pipeline as proposed. On balance, no further surveys are recommended.

7.3.15 Within Zones 3 and 4 (Mucking Section), the magnitude of change is considered

low. There is potential for archaeological features of high importance, but the width of impact is limited.

7.4 Archaeological mitigation strategy

7.4.1 In accordance with guidance contained in PPS5, procedures will be agreed with the local authority to manage the pipeline construction process so that opportunities exist either to preserve significant archaeological remains in situ or, if that is not feasible, to carry out investigation to enhance understanding of the remains before they are lost.

Zone 1 - Former tidal flats

7.4.2 Zone 1 comprises areas mapped by BGS as Tidal Flat deposits, between Shell Haven and Corringham, an area of reclaimed marshland. Significant archaeology in Zone 1 is likely to be very sparsely distributed, except at the interface of the tidal flats with the gravel terrace, which is considered separately below (Zone 1 / 3). Monitoring of soil stripping during construction in Zone 1 would not be productive, except in recording near-surface modern military, industrial and transport features. Monitoring of the pipe trench excavation (to a depth of c 3m) has a greater chance of encountering medieval or Roman marine or intertidal features. However the results of trenching in the Northern Triangle suggests that the potential for locating archaeology in the upper alluvium is very low. Mitigation will comprise targeted monitoring during construction, to record specific details of archaeological features that are directly affected by the pipeline.

Zone 1 / 3 - Terrace/ floodplain interface

7.4.3 This zone extends from Corringham to north of Stanford Industrial Park, and includes the interface between the gravel terrace and the Thames floodplain (See Figure 2 - the interface between Zone 1, Tidal Flat deposits, and Zone 3, Undifferentiated Head). Significant archaeology, comprising 12th-16th century creek-side activity, possibly representing a medieval manorial wharf, has been found along the terrace edge during previous investigations at three separate locations along the terrace edge.

7.4.4 This transitional zone includes the north-west edge of the Tidal Flats, and the head of a large tidal creek (Carter's Creek).

7.4.5 The pipeline route has been aligned c 100m north of the existing Coryton Power Station gas pipeline, to avoid known medieval archaeology found during its construction (OA57). The pipeline in this route section lies within Zone 3, and any archaeology is therefore likely to be buried at shallow depth (c. 0.3m - 0.5m).

7.4.6 There is a significant risk that complex waterlogged organic artefacts, such as boats or wharf structures, could be found within the upper 3m of the Tidal Flat deposits, immediately south-east of the terrace edge (the highest area of risk includes OA46, 57, 166, 180, 363 and 364, Figure 2 and Table 5). Temporary works in this area should therefore be avoided.

7.4.7 Construction activities in this zone, with a significant below ground construction impact will be subject to 'strip, map and sample (SMS) excavation'. The soil stripping will be carried out as an early construction activity, allowing a sufficient programme window for archaeological investigations and recording to take place as the pipeline proceeds.

Zones 3 and 4 - Gravel terrace, Stanford-le Hope section

7.4.8 Zone 3 is defined as areas mapped by BGS as Undifferentiated Head deposits.

Zone 4 is areas mapped as River Terrace deposits, including River Terrace 2 and 3, Lynch Hill and Taplow gravels. This zone runs from Great Garlands Farm to Mucking Creek. Extensive cropmarks are present, except in sections close to Mucking Creek/ Hassenbrook (Zone 4) which have been extensively quarried. The densest areas of cropmarks and archaeological evidence seen from the geophysical surveys are concentrated on the River Terrace 3 gravels (Zone 4) rather the Head deposits (Zone 3), but this may be a matter of visibility to these survey techniques rather than reflecting real archaeological potential.

7.4.9 The route has been selected to avoid impacting upon areas of dense cropmarks. Any archaeological features in this zone are likely to be found at depths of c 0.3m - 0.5m (beneath ploughsoil). Mitigation in this zone will generally comprise topsoil stripping under archaeological control ('SMS excavation'). The soil stripping will be carried out as an early construction activity, allowing a sufficient programme window for archaeological investigations and recording to take place if significant archaeology is found. Construction activities expected to be mitigated by this method includes the main pipeline easement. Less extensive or temporary groundworks involving excavation, such as temporary access roads/ works compounds and cable trenches, may be mitigated either by SMS excavation or monitoring during construction, depending on the scale, timing and detailed method of the groundworks in each case. The proximity to known archaeological remains will also be a determining factor in deciding the scope of mitigation.

Zone 2 - Mucking Creek / Hassenbrook crossing

7.4.10 This route section is located at the crossing of the Hassenbrook / Mucking Creek, and is defined as areas mapped by BGS as Alluvium (Figure 2). The Roman salterns excavated at LG Stanford Wharf Nature Reserve lie within this topographical zone. The former site of Cabborn's Manor, and the village of Mucking lie at the interface between the Taplow gravel and Holocene alluvium infilling Mucking Creek. The route in this section will be constructed by HDD, at a depth of c 4m - 5m, within the solid geology and below any surviving archaeological deposits. No mitigation is required.

Zones 3 and 4 - Gravel terrace, Mucking section

7.4.11 This route section includes areas mapped by BGS as Head deposits between Mucking Creek and the pipeline terminal, to the west of Mucking Village (Figure 2). Any archaeological features in this zone are likely to be found at depths of c 0.3m - 0.5m. Mitigation in this zone will initially comprise topsoil stripping under archaeological control ('SMS' excavation). Depending on the significance of the remains, detailed excavation and recording is likely to be required. The soil stripping will be carried out as an early construction activity, allowing a sufficient programme window for archaeological investigations and recording to take place. Construction activities expected to be mitigated by this method include the main pipeline easement. Less extensive or temporary groundworks involving excavation, such as temporary access roads/ works compounds may be mitigated as for the main pipeline easement, or subject to monitoring during construction, depending on the scale, timing and detailed method of the groundworks in each case. The proximity to known archaeological remains will also be a determining factor in deciding the scope of mitigation.

Further mitigation

7.4.12 In all areas, the results from exploratory trenches, SMS or monitoring during construction may result in the discovery of significant archaeological remains. Such remains may require measures to preserve them in situ. If physical preservation is not possible, detailed investigation and recording may be required

to advance understanding of the sites before they are lost.

7.5 Residual effects on archaeology after mitigation

Zone 1 - Former tidal flats

7.5.1 After the mitigation measures described above, potential residual effects on buried archaeology in this zone are considered uncertain, but are likely to be insignificant.

Zone 1 / 3 Terrace/ floodplain interface

7.5.2 After the mitigation measures described above, potential residual effects on buried archaeology in this zone are considered uncertain, but are likely to be minor adverse or insignificant, depending on the extent and importance of the remains encountered.

Zones 3 and 4 - Gravel terrace, Stanford-le Hope section

7.5.3 After the mitigation measures described above, potential residual effects on buried archaeology in this zone are considered uncertain, but are likely to be minor adverse or insignificant, depending on the extent and importance of the remains encountered.

Zone 2 - Mucking Creek / Hassenbrook crossing

7.5.4 After the mitigation measures described above, potential residual effects on buried archaeology in this zone are considered uncertain, but are likely to be insignificant, depending on the extent and importance of the remains encountered.

Zones 3 and 4 - Gravel terrace, Mucking section

7.5.5 After the mitigation measures described above, potential residual effects on buried archaeology in this zone are considered uncertain, but are likely to be minor adverse or insignificant, depending on the extent and importance of the remains encountered.

8 ASSESSMENT OF HISTORIC BUILDINGS AND CONSERVATION AREAS

8.1 Baseline data

8.1.1 Sixteen Grade 2 Listed Buildings are present within the route study area (Table 4, Figure 1). They range in date from the medieval period to the 18th century and include the Grade I listed parish church of St. Mary's, Corringham (OA158) and the Grade II* listed former parish church of St.John's, Mucking (OA129). Otherwise all of the historic buildings in the route study area are Grade 2 Listed, comprising a range of domestic and farm buildings, the majority of which fall within Corringham Conservation Area.

8.1.2 No non-designated heritage assets which form part of the built environment will be affected by the pipeline construction. Extant historic earthworks and transport infrastructure are considered below under 'historic landscape'.

8.2 Permanent effects

8.2.1 As none of the historic buildings within the study area, or their curtilages, lie within 100m of the pipeline route, the construction of the pipeline will have no permanent

physical impact upon them (Figure 3 and Table 4).

8.2.2 As the pipeline itself is below-ground, and the vast majority of the route will be returned to agriculture, it will have no permanent effect on the visual setting of any Listed Building or Conservation Area. As none of the above-ground infrastructure associated with the pipeline lies within 500m of a Listed Building or Conservation Area, and the infrastructure is limited in extent, there will be no permanent visual effect from that source either.

8.3 Temporary effects during pipeline construction

8.3.1 Temporary adverse visual and noise impacts will occur during the pipeline construction, as a result of construction traffic, and the installation of temporary access roads and compounds. Corringham Church (Grade I listed) and the former Mucking Church (Grade II* listed) are of very high importance, but the magnitude of change to both is negligible. Corringham Conservation Area and the other Grade II listed buildings within the route study area are of high importance. In most cases the magnitude of change caused by temporary effects during construction is negligible, as the pipeline route is not sufficiently close for construction traffic to affect the buildings. However, Great Garlands and Old Garlands (both Grade II listed), lie sufficiently close to the pipeline that they will be adversely affected by construction traffic. Without mitigation, the significance of the temporary effects to Great Garlands and Old Garlands is expected to be minor adverse.

8.4 Mitigation

8.4.1 During construction operations, the maximum possible distance will be maintained from Listed Buildings. Construction traffic will be diverted away from the historic village centres.

8.4.2 Significant temporary adverse effects on the setting of Great Garlands/ Old Garlands are likely to be unavoidable, but will be mitigated as far as reasonably practicable by construction of temporary screens and/ or soil bunds.

8.5 Ongoing effects during operation

8.5.1 There will be no ongoing effects on Listed Buildings or Conservation Areas or non-designated heritage assets or their settings as a result of operation of the pipeline.

8.6 Residual effects

8.6.1 Corringham Church (Grade I listed) and the former Mucking Church (Grade II* listed) are of very high importance, but the magnitude of change to both is negligible before and after mitigation, so the residual effects are insignificant.

8.6.2 Corringham Conservation Area and the other Grade II listed buildings within the route study area are of high importance. However, in most cases the magnitude of change, before and after mitigation, is negligible, as the pipeline route is not sufficiently close to affect the buildings. However, Great Garlands and Old Garlands (both Grade II listed), lie sufficiently close to the pipeline that they will suffer temporary adverse effects to the setting of the buildings, comprising noise and visual intrusion caused by construction traffic. After mitigation, the significance of the temporary effects to Great Garlands and Old Garlands is expected to remain minor adverse, or be reduced to an insignificant level following effective

screening measures.

9 HISTORIC LANDSCAPE ASSESSMENT

9.1 Baseline data

9.1.1 The pipeline route follows a broad rural buffer zone, located between the extensive 20th century housing developments to the north of Stanford-le-Hope and Corringham, and the reclaimed marshlands occupied by the former Shell Haven Oil Refinery to the south-east. The route is similar to that of the former Corringham Light Railway (OA 210), from Shell Haven as far as Corringham.

9.1.2 The edge of gravel terrace forms a distinct divide between the anciently enclosed landscape of rectilinear fields on the gravel terrace, and the sinuous boundaries and trackways of the reclaimed saltmarsh below. The latter follow the lines of relict creeks and sea walls, which commonly survive as low earthworks. This reclaimed marshland landscape has been extensively modified by land reclamation (since the early 17th century) and subsequent drainage and agricultural improvement. The land retains a flat, treeless, open aspect, but otherwise much of the marshland character has been eroded and subject to visual intrusion, most notably from industrial refinery buildings on the skyline, the A1014 Manor Way and overhead power lines. The reclaimed marshland has generally been subject to less intensive cultivation than the fields on the terrace, leading to the extensive survival of historic earthwork features. However where these can be dated they are of post-medieval and modern date. Geoarchaeological modeling suggests that any earlier features within the floodplain should be buried beneath significant depths of alluvium. The only known exception within the study area is the probable medieval Wharf site to the south-east of Great Garlands Farm (comprising OA 57 and adjacent earthworks to the south), which occurs at the very edge of the floodplain.

9.1.3 The central section of the route skirts the edge of the Thames floodplain, passing close to the historic village and Conservation Area of Corringham, following the edge of the former marshes as far as Great Garlands Farm, from where it crosses onto the terrace. The higher ground of the gravel terrace offers extensive views over the Thames Estuary. The rectilinear field system on the gravel terrace is a characteristic feature of the south Essex landscape. The general pattern of lanes and boundaries generally takes its alignment from the River Thames and may have its origins in the later prehistoric or Romano-British periods (Ref 22). The ancient landscape of rectilinear field boundaries is still largely intact, traceable on historic maps and on the ground as earthworks and hedgerows, typically lined with low scrub vegetation. The historic map evidence suggests that limited rationalisation of field boundaries has occurred in the course of 20th century, combining fields to accommodate the needs of mechanised farming (Figure 2).

9.1.4 At the Mucking end of the route, on either side of Mucking Creek, the landscape has been extensively disturbed by quarrying, some of the quarries being retained in the present landscape as fishing lakes. The quarry pits to the West of Mucking have been used extensively as land-fill sites.

9.2 Permanent effects

9.2.1 The historic landscape as a whole is considered to be of medium importance, as it includes some surviving coherent historic landscape elements, but is otherwise somewhat eroded. As the pipeline itself is below-ground, and the vast majority of the route will be returned to agriculture, it will have no significant permanent visual

effect on the historic landscape. The above-ground infrastructure associated with the pipeline is limited in extent, so there will be no permanent visual effect from that source either.

9.2.2 The pipeline construction will cause direct and permanent physical impacts to the following heritage assets, which survive as partially extant earthworks, and are considered to be elements of the historic landscape (Figure 3 and). In all of the following cases the magnitude of change is negligible, due to the very narrow width of the pipeline corridor, compared with the large extent of the affected features.

- Extensive areas of 'stetch' cultivation ridges, in the area to the north of the A1014 (low importance)
- The Corringham Light Railway (OA210 - medium importance)
- WWII anti-glider ditches (OA55 - low importance)

9.2.3 The effect of the pipeline construction before mitigation is considered insignificant in relation the three heritage assets identified above, and the historic landscape as a whole.

9.3 Temporary effects during pipeline construction

9.3.1 Temporary adverse visual and noise impacts will occur during the pipeline construction, as a result of construction traffic, and the installation of temporary access roads and compounds. The route for the most part is rural in character, passing through a partially preserved historic landscape, overlooked by settlements on the river terrace. However, taking into consideration the fact that the majority of these settlements lie more than 500m from the pipeline, the magnitude of change is negligible. The fact that the historic landscape is already overlain by visually intrusive elements, such as the A1014 and overhead cables, is a factor in this assessment.

9.4 Mitigation

9.4.1 It is proposed that a targeted watching brief be maintained on specified sections of the pipeline easement, designed to record specific details of the Corringham Light Railway, if necessary.

9.4.2 Existing Lidar and aerial photographic data generally forms a sufficient plan record of areas of stetch cultivation to the north of the A1014 Manor Way, and the WW2 anti-glider ditches. However, profiles through these features will need to be recorded where they are cut by the pipeline. This will be undertaken during a targeted watching brief on the pipeline soil stripping.

9.5 Ongoing effects during operation

9.5.1 There will be no ongoing effects on the historic landscape as a result of operation of the pipeline.

9.6 Residual effects

9.6.1 The residual effect on the historic landscape of building the pipeline is considered insignificant.

10 REFERENCES

Ref 1 DETR, nd Cultural heritage / material assets of preparation of environmental statements for planning projects that require environmental assessment: A good practice guide

Ref 2 IFA (2008). Standards and Guidance for Archaeologists. Institute of Field Archaeologists

Ref 3 Archaeological desk-based assessment of the GEC development (PB January 2010, Ref 3)

Ref 4 Environmental Statement (ES) for the Section 36 consent application for GEC (PB February 2010, Ref 4)

Ref 5 The London Gateway Port Harbour Empowerment Order 2002. Assessment of effects on cultural heritage in respect of the proposed development of London Gateway Port Development. Prepared by Oxford Archaeology for P&O, published July 2002.

Ref 6 The London Gateway Logistics and Commercial Centre. Outline Planning Application 2002. Assessment of effects on cultural heritage in respect of the proposed development of London Gateway Port Development. Prepared by Oxford Archaeology for P&O, published July 2002.

Ref 7 The London Gateway Logistics and Commercial Centre, Transport and Works Act Order 2002. Assessment of effects on cultural heritage in respect of the proposed development of London Gateway Commercial Development. Prepared by Oxford Archaeology for P&O, published July 2002.

Ref 8 Highways Agency 2007, Design Manual for Roads and Bridges (DMRB 2007, HA 208/07 Vol.11, Section 3, Part 22)

Ref 9 London Gateway Logistics and Commercial Centre Outline Planning Application. Archaeological surveys and up-date of assessment of impacts on cultural heritage in respect of the proposed development of London Gateway Logistics and Commercial Centre. Technical Report Volume 1. Prepared by Oxford Archaeology for P&O, July 2002 (includes Phase 1 Access Road corridor magnetometer survey report and fieldwalking report)

Ref 10 London Gateway Logistics and Commercial Centre Outline Planning Application. Cultural heritage assessment refinement in respect of the proposed development of London Gateway Logistics and Commercial Centre. Technical Report Volume 2. Prepared by OA for P&O (includes Phase 2 Access Road corridor magnetometer survey report) Prepared by Oxford Archaeology for DP World, March 2003

Ref 11 OA, March 2010, London Gateway Main Port and Park Access Road: Project Design for Archaeological Trenching, prepared by Oxford Archaeology for DP World

Ref 12 OA, July 2010, London Gateway Main Port and Park Access Road: Archaeological Investigation Report, prepared by Oxford Archaeology for DP World,

Ref 13 OA, July 2008 London Gateway: Geoarchaeological deposit model interim report; prepared by Oxford Archaeology for DP World

Ref 14 OA, August 2008 London Gateway: Project design for site-wide palaeoenvironmental study; prepared by Oxford Archaeology for DP World

Ref 15 OA, August 2008, London Gateway: Project design for site-wide palaeoenvironmental study; Oxford Archaeology for DP World

Ref 16 OA, September 2008, London Gateway: Archaeological investigation report; Northern Triangle East, Habitat Creation and enhancements, Oxford Archaeology for DP World

Ref 17 OA, April 2009, London Gateway: A geophysical assessment report on the sub-surface stratigraphy of the Shell Haven site, Corringham, Essex. Bates R and Bates M for Oxford Archaeology/ DP World

Ref 18 OA, April 2009, London Gateway Compensation Site A, Archaeological trenching investigation report, Oxford Archaeology for DP World

Ref 19 OA, May 2009, London Gateway Compensation Site A, Project Design for Archaeological Mitigation, Oxford Archaeology for DP World

Ref 20 OA, October 2010, Stanford Wharf Nature Reserve, London Gateway, Stanford-le-Hope, Essex, Post-excavation assessment and updated project design, Oxford Archaeology for DP World

Ref 21 ECC, May 2011, Aerial photographic assessment of the proposed Corringham gas pipeline corridor, Essex County Council Historic Environment Branch, for GEC

Ref 22 Williamson T, 1986, Parish boundaries and early fields: continuity and discontinuity, *Journal of Historical Geography*, Volume 12, Issue 3, July 1986, 241-248

Ref 23 Essex Records Office T/A 902/1, Catalogue of deeds and papers relating to Old Garland's Farm, Stanford-le-Hope 1591-1920. Part of the catalogue of the Hawkin's Hospital, Chatham

Ref 24 Saunders A, 1988, *A Short History of the Church and Village of Stanford-le-Hope*

Ref 25 Peachey, M and Dale, R. 2005, A late Medieval Site at Great Garlands Farm, *Essex Archaeology and History*, volume 36

Ref 26 Bedwin O (1996) *The Archaeology of Essex: proceedings of the 1993 Writtle conference*. Essex County Council

Ref 27 Bingley R (1997) *Fobbing - Life and Landscape.* Lejins Publishing. Stanford-le-Hope

Ref 28 Bridgland DR (1994) *Quaternary of the Thames*. Chapman and Hall

Ref 29 Brown NR & Glazebrook J (eds) (2000) *Research and Archaeology: A Framework for the Eastern Counties I. Resource Assessment*. East Anglian Archaeology Occasional Paper 3

Ref 30 Brown NR & Glazebrook J (eds) (2000) *Research and Archaeology: A Framework for the Eastern Counties II. Research Agenda*. East Anglian Archaeology Occasional Paper 8 (2000)

Ref 31 Buckley DG (ed) (1980) *The Archaeology of Essex to AD1500*. Essex County

Council

Ref 32 Clark A (1993) *Excavations at Mucking*. English Heritage. London

Ref 33 Darby HC (1971) *The Domesday Geography of Eastern England*. Cambridge University Press

Ref 34 Devoy RJ (1980) Post-glacial Environmental Change and Man in the Thames Estuary: a synopsis, in Thompson F (ed) *Archaeology and Coastal Change*, Soc. Antiquaries London Occasional Paper 1

Ref 35 ECC FAU (1997) *Mobil Power Cogeneration Gas Pipeline Project, Coryton to Mucking, Essex. Archaeological Desk-based Asssessment*. Essex County Council Field Archaeology Unit. ECC Internal Report.

Ref 36 ECC FAU (March 2001) *Mobil Power Cogeneration Gas Pipeline Project, Coryton to Mucking, Essex. Archaeological Monitoring and Excavation*. Essex County Council Field Archaeology Unit. Client Report.

Ref 37 Fulford M, Champion T & Long, A (1997) *England's Coastal Heritage.* RCHME/English Heritage Archaeological Report 15

Ref 38 Gibbard PL (1994) *Pleistocene History of the Lower Thames Valley, Cambridge* University Press

Ref 39 Glazebook J (ed) (1997) *Research and archaeology; A Framework for the Eastern Counties I*. *Resource Assessment.* East Anglian Archaeology Occasional Paper 3

Ref 40 Green LS (ed) (1999) *The Essex Landscape: In Search of its History. The 1996 Cressing Conference*. Essex County Council Planning.

Ref 41 Hudson K (1984) *Industrial History From the Air*

Ref 42 Hunter J (1999) *The Essex Landscape. A study of its former history*. Essex Record Office.

Ref 43 Kay P (1999) *The Thames Haven Railway*

Ref 44 Merriman N (1990) *Prehistoric London*. HMSO

Ref 45 MoLAS (2000) *The Archaeology of Greater London.* HMSO

Ref 46 Morris J (1983) *Domesday Book: Essex*. Phillimore. Chichester.

Ref 47 OAU (1994) *Channel Tunnel Rail Link: Assessment of Historic and Cultural Effects. Final Report*. Oxford Archaeological Unit

Ref 48 OAU (1995) *Thames Gateway Archaeological Framework*. Oxford Archaeological Unit

Ref 49 Rackham O (1987) *The History of the Countryside*. JM Dent & Sons Ltd. London.

Ref 50 Scott WN (1982) *Coryton. The History of a Village*

Ref 51 Sparkes IG (1965) *Corringham: Village and Marshes.* Thurrock Local History Reprints No. 4.

Ref 52 Taylor J. (2007) An Atlas of Roman Rural Settlement in England. London: CBA Research Report 151

Ref 53 Wilkinson TJ& Murphy PL (1995) *The Archaeology of the Essex Coast, Volume 1: The Hullbridge Survey.* Essex County Council. East Anglian Archaeology Report 71

Ref 54 Williams J & Brown N (eds) (1999) *An Archaeological Framework for the Greater Thames Estuary*. Essex County Council

Ref 55, August 2004, Historic Environment Characterisation Project, Thames Gateway, Final Report. Chris Blandford Associates for English Heritage

Ref 56, June 2011, East Thurrock Connection, Report on Archaeological Geophysical Survey, Bartlett-Clark Consultancy, on behalf National Grid and Atkins Limited

Other Sources

Ashmolean Library, Oxford

Bodleian Library Map Room, Oxford

English Heritage Data Team, London

Essex Record Office, Chelmsford

Essex County Council Sites and Monuments Record

National Monuments Record Centre

St Helens Court Bulletin Volumes 1-5 (1914-1919)

The Pipeline Volumes 1-5 (1921-25)

Cartographic Sources
ERO = Essex Record Office

Chapman and André's Map of the County of Essex (1771)

Ordnance Survey 1" Map (1805)

Corringham Parish Plan (1818) ERO T/M 93/1

Thames Haven Railway (1835) ERO Q/Rum 1/55

Detail of route of railway through Stanford-le-Hope (1835) ERO D/DOp/B37/3

Corringham Tithe Map (1839) ERO D/C/T106B

Fobbing Tithe Map (1839) ERO D/C/T141B

Stanford-le-Hope Tithe Map (1840) ERO D/C/T362B

Mucking Tithe Map (1846) ERO D/C/T246B

Plan of Thames Haven Docks etc (1856) ERO Q/Rum 2/107

Detail of route of railway through Mucking ERO D/DOp/B37/5

Boundaries alterations (1962) ERO D/C/Pc400

Birds Eye View of Thames Haven ERO D/OU 567/30

Plan of tide dock & railway ERO D/DOp/B103

Ordnance Survey 1st Edition 6” Map (surveyed in 1863, published in 1870)

Ordnance Survey 2nd Edition 6” Map (1898 edition - surveyed in 1863, revised 1895)

Ordnance Survey 2nd Edition 6” Map (1924)

Ordnance Survey 6” Map (1938)

Ordnance Survey 6” Map (1960)

Ordnance Survey 1:10,000 Map (1976)

British Geological Survey Solid and Drift Edition (1976). Sheet 258

Table 4: Gazetteer of Listed Buildings within 500m of the proposed pipeline, incorporating summary heritage assessment

Abbreviations used:
NMR = National Monument Record
SMR = Sites and Monuments Record, now termed HER (Historic Environment Record)
MEX = Museum of Essex

Gazetteer Number	Receptor Type	Sources	Description	OS Easting	OS Northing	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
128	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR 35298, MEX1010704	The vicarage. House	568486	181144	High	Negligible (lies over 100m from the nearest route)	No significant effect	Maintain maximum possible distance. Sensitive low-level, non-intrusive design for above-ground infra-structure. Screen with landscaping. Route construction traffic away from Mucking village.	Insignificant
129	DoE List of Buildings of Architectural or Historical Interest. Grade II*	SMR 35297, MEX1010703	Church of St John the Baptist, Mucking. Church	568532	181181	Very high	Negligible (lies over 100m from the nearest route)	No significant effect	Maintain maximum possible distance. Sensitive low-level, non-intrusive design for above-ground infra-structure. Screen with landscaping. Route construction traffic away from Mucking village.	Insignificant
130	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR 35299, MEX1010705	Mucking Hall. Timber Framed House	568522	181056	High	Negligible (lies over 100m from the nearest route)	No significant effect	Maintain maximum possible distance from works	Insignificant
151	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR35219, MEX1010625	1 and 2 Herd Lane. Thatched House.	571139	183560	High	Negligible (lies over 100m from the nearest route)	No significant effect	Maintain maximum possible distance from works	Insignificant
153	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR 35185, MEX1010591	Rose Cottage. House.	570928	183440	High	Negligible (lies over 100m from the nearest route)	No significant effect	Maintain maximum possible distance from works	Insignificant
154	DoE List of Buildings of Architectural or Historical	SMR 35343, MEX1010752	Bush House. Timber Framed House	570925	183380	High	Negligible	No significant effect	Maintain maximum possible distance from works	Insignificant

Gazetteer Number	Receptor Type	Sources	Description	OS Easting	OS Northing	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
	Interest Grade II									
155	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR 35344, MEX1010753	Fearings Farmhouse. Timber Framed House	570937	183347	High	Negligible	No significant effect	Maintain maximum possible distance from works	Insignificant
156	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR 35186, MEX1010592	Bell House. Timber Framed House	570978	183366	High	Negligible	No significant effect	Maintain maximum possible distance from works	Insignificant
157	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR 35187, MEX1010593	Bull Inn. Inn	571000	183336	High	Negligible	No significant effect	Maintain maximum possible distance from works	Insignificant
158	DoE List of Buildings of Architectural or Historical Interest Grade 1 Listed.	SMR 35184, MEX1010590	Church of St Mary, Corringham. Church.	570985	183290	Very high	Negligible	No significant effect	Maintain maximum possible distance from works	Insignificant
159	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR 35189, MEX1010595	Corringham Hall. House.	571044	183228	High	Negligible	No significant effect	Maintain maximum possible distance from works	Insignificant
160	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR 35188, MEX1010594	Hall Farm Cottages. Timber Framed House	571003	183321	High	Negligible	No significant effect	Maintain maximum possible distance from works	Insignificant
161	DoE List of Buildings of Architectural or Historical	SMR 35361, MEX1010771	Old Hall. House	570704	183015	High	Negligible	No significant effect	Maintain maximum possible distance from works	Insignificant

Gazetteer Number	Receptor Type	Sources	Description	OS Easting	OS Northing	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
	Interest									
162	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR 35289, MEX1010695	Black weather-boarded barn at Old Garlands Farm. Timber Framed House.	570355	182559	High	Low	Standing building affected by noise and visual impacts on a temporary basis during pipeline construction.	Maintain maximum possible distance from works NB: This building is also visually affected by the proposed LG Access Road.	Minor adverse or insignificant
163	DoE List of Buildings of Architectural or Historical Interest Grade II	SMR 35250, MEX1010656	Great Garlands Farmhouse with stable to the north-west. House and stable.	570367	182403	High	Low	Standing building affected by noise and visual impacts on a temporary basis during pipeline construction.	Maintain maximum possible distance from works	Minor adverse or insignificant

Table 5: Gazetteer of all identified heritage assets within 500m of the proposed pipeline incorporating summary heritage assessment

Abbreviations used:
NMR = National Monument Record
SMR = Sites and Monuments Record, now termed HER (Historic Environment Record)
MEX = Museum of Essex

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
1	Settlement	SMR 5229, MEX18041	Evidence of Iron Age occupation at this location. No further information on SMR.	568150	180900	High	Low (lies within 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: Potential effect from pipeline installation and / or temporary enabling works	SMS excavation	Uncertain (likely to be minor adverse or insignificant)
2	Find spot	NMR 414097, SMR 1897, MEX6911	Roman pottery found by chance by MR Hull in 1931. There is some confusion in the SMR and NMR as to whether the pottery was discovered at more than one location in this general area or whether there was a single findspot (see also Site 4).	568710	180920	Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
4	Find spot	NMR 414096; SMR 1888,1893, 1894,1895, MEX6886, MEX6901, MEX6907, MEX6909	Roman pottery found by chance by MR Hull in 1931. There is some confusion in the SMR and NMR as to whether the pottery was discovered at more than one location in this general area or whether there was a single findspot (see also Site 2).	569000	181100	Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
5	Archaeological Investigation	SMR 19212, MEX1032763	Archaeological monitoring on geotechnical test pits at Wharf Road in 2000 identified peat deposits.	569300	181100	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
6	Find spot	NMR 414095, SMR 1891, MEX6891	A Roman burial group comprising a flask, a bowl, a beaker were found in 1886 100 yards north of Mucking Church. Dated to the 2nd century AD.	568530	181260	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
7	Find spot	NMR 414090, SMR 1892, MEX6894	Palaeolithic implements including flakes and handaxes were found by Worthington Smith and Reverend B Hale Wortham in a gravel pit at Mucking in the late 19th century.	568500	181499	Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
8	Find spot	SMR 1896. MEX6910	Chance find of Iron Age pottery from a gravel pit.	569000	181300	Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
9	Archaeological Investigation	SMR 5188, MEX17897	Roman pottery, brick, wood and animal bones found in a flint-lined well in 1967. Large-scale excavations during construction of Stanford-Wharf Nature Reserve in 2009 revealed extensive Iron Age / Romano-British salt-making at two separate locations at the terrace edge. Most intensive activity is in the Roman period. A piled early Roman rectangular structure may be a boathouse? At least one roundhouse. There is evidence for a change in production and increase in range of economic activities in the 3rd-4th centuries, including a substantial 4 post circular building next to Mucking Creek (salt-store or watch-tower?)	569500	181000	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
10	Find spot	SMR 5186, 5187, MEX17893, MEX17896	Findspot of Roman and medieval pottery found by chance in 1970. Finds were from the beach, from sea erosion outside the sea wall.	569500	181000	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
11	Building	SMR 15128, MEX1032226	Explosives Factory No longer extant	569900	181400	Low	Negligible	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
12	Cropmarks	SMR 5259, MEX18151	Air photographs show two complete ring-ditches at this location (digitally plotted as part of NMP) and several linear	569700	181600	Medium	Moderate (lies over 100m from the pipeline	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
		Updated by ECC 2011	cropmarks (not plotted but would appear to be archaeological). New coverage obtained 2006-2010 by ECC and plotted for this EIA (ECC May 2011).				route)			
13	Archaeological Investigation	NMR 1075808	ECCFAG watching brief carried out in 1994 at eastern end of Mobile Power Congeneration Gas Pipeline. The investigation identifed no archaeology.	568574	181564	Very Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
14	Site of Building	SMR 5209, 5210, MEX17976, MEX17978	Site of medieval moated manor, destroyed in 20th century. 15th century two-storied hall house with cross wings and cellar. Alterations in 16th/17th centuries. Probably associated with Caborne family (mentioned in 1429). Site mostly destroyed by quarrying	568870	181620	High	High (lies within 50m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct impact as pipeline will be installed by HDD	None	Uncertain (likely to be insignificant)
15	Archaeological Investigation	NMR 937582	ECCAS carried out a watching brief during the construction of a golf course in 1992. Finds included prehistoric worked flint and burnt flint, Late Bronze Age pottery and a medieval hearth.	568300	181600	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
16	Find spot	SMR 5258, MEX18147	Site visit during topsoil stripping in 1977 revealed 19th pottery fragments but no archaeology.	568150	181700	Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
18	Find spot	SMR 5255, MEX18143	Sherd of Roman pottery and a sherd of Iron Age pottery and flints found by chance at this location in 1970.	568690	181940	Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
35	Archaeological Investigation	NMR 656624	Thurrock Museum carried out a watching brief in 1988, which revealed evidence of prehistoric settlement.	569300	182200	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
36	Cropmarks	SMR 14700, MEX39944	Linear and rectilinear cropmarks of a possible trackway, field boundaries and one, possibly two, enclosures, visible on air	569400	182000	High	High (lies within 50m from the pipeline	Visual: N/A Temporary: N/A Permanent: Probable direct effect from pipeline installation	SMS excavation	Uncertain (likely to be minor adverse or

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
			photographs. (Not plotted on new AP coverage by ECC, May 2011).				route)			insignificant)
39	Cropmarks	SMR 14702, MEX39949	Cropmarks of a possible trackway, linear features and a possible ring-ditch, visible on air photographs. (Not plotted on new AP coverage by ECC, May 2011).	569800	182500	medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
40	Historic map evidence	Chapman and Andre's map of 1771	Chapman and Andre's map of 1771 shows an enclosed field (woodland?) at this location. It is not clear whether there are buildings here.	569859	182211	low	Medium (lies within 100m from the pipeline / cable route)	Visual: N/A Temporary: N/A Permanent: Potential effect from pipeline installation if the site is subject to subsidiary access road or enabling works for pipeline/cable construction or ancillary works.	None	Uncertain (likely to be minor adverse or insignificant)
41	Site of Building	Chapman and Andre's map of 1771	Broadhope Farm. Chapman and Andre's map of 1771 shows three separate farms/homesteads along the side of the road. No longer extant. OAU site visit noted a number of sub-circular cropmarks possibly marking the site of field boundaries.	570038	181955	Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Temporary: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
42	Cropmarks	SMR 7131, 7132, MEX23435, MEX23438	Area of cropmarks visible on air photographs. Noted on SMR as possible cropmark complex and identified as a possible deserted medieval village in a Thurrock Museum report. Possibly the same as 164? (Not plotted on new AP coverage by ECC, May 2011).	570275	181699	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	SMS excavation	Insignificant
43	Find spot	SMR 7223, 7224, 7225, 7226, MEX23627, MEX23628, MEX23629, MEX234330	Roman pottery sherds found in foreshore mud by chance in 1972-3 and on a separate occasion before 1987.	570300	181200	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
44	Find spot	SMR 7130, MEX23434	Roman pottery sherds and terra sigillata found in foreshore mud by chance in 1972-3	570300	181200	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
45	Find spot	NMR 417014, SMR 7138, 7139, MEX23445	Roman pottery has been found on the foreshore at this general location over 'many years'.	570700	181400	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
46	Earthworks	OAU site visit.	OAU site visit identified Earthwork platform c. 15 m long, adjacent to sea wall. Possible structure platform (associated with medieval/ post-medieval wharf?	570887	182261	Medium	Medium (lies within 100m from the pipeline route)	Visual: Minor adverse Permanent: No direct effect from pipeline installation	Review detailed design. Minimise depth of impact. SMS and / or watching brief on groundworks	Uncertain, likely to be insignificant
55	Site of military Feature	SMR 14763, MEX40098	Aircraft obstruction	572600	182900	Low	Negligible (lies over 100m from the pipeline / cable route)	Visual: N/A Permanent: No direct effect from pipeline installation	SMS excavation	Insignificant
56	Building	SMR 35251, MEX1010657	Site of 18th century timber-farmed Barn south of Great Garlands farmhouse. Previously Listed.	570393	182365	Low	Medium (lies within 100m from the pipeline / cable route)	See Table 4	See Table 4	
57	Archaeological Investigation	NMR 1336812	ECCAS watching brief on a pipeline in 1999 identified the remains of an extensive area of medieval activity including cobbled surfaces, evidence of industrial activity, a building, pit and other features dating to the 14th - 16th centuries.	570550	182250	High	High (lies within 50m from the pipeline / cable route)	Visual: None Permanent: Potential effect from pipeline installation if the site is subject to subsidiary access road or enabling works for pipeline/cable construction or ancillary works.	SMS excavation	Uncertain/ Possibly minor adverse
58	Cropmarks	SMR 17169; specialist air photo of complex EXC 16934/11 NMR TQ 7082/8 14/6/96: vertical air photo of sub-oval cropmark ot the east: MAL/75015 Fr. 073 9/APR/75	Cropmarks of numerous rectilinear features, including two sub-rectangular enclosures, noted on SMR. New coverage obtained in 2006-2010 by ECC and plotted for this EIA (ECC May 2011).	570400	182600	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
		Updated by ECC 2011								
59	Historic map evidence	Chapman and Andre's map of 1771	Chapman and Andre's map of 1771 shows an enclosed field at this location. No buildings are shown.	570101	182550	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
60	Site of Building	Sparkes (1965) Corringham. Thurrock Local History Reprints.; Chapman and Andre's map of 1771	Site of manor house on or in the vicinity of Oak Farm. Built in the 17th century. Chapman and Andre's map of 1771 Shows buildings at this location marked 'Warrents'. Demolished in 1963.	570220	182669	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
61	Site of Building	Chapman and Andre's map of 1771	Chapman and Andre's map of 1771 shows buildings at this location marked 'Coggars'. OAU site visit noted a c. 10 m diameter circular depression at this location.	570409	182900	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
64	Find spot	SMR 7214, 7215, MEX23611, MEX23614	Three sherds of later medieval pottery and Roman tile found in the make-up of a former track to Old Hall during a watching brief in 1969-70.	570570	183240	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
67	Archaeological Investigation	SMR 19214, MEX1032746	Archaeological watching brief in 1992 revealed the remains of a modern workshop. Lies within conservation area.	570900	183400	High	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
68	Site of Military Feature	SMR 10316, MEX31857	Spigot Mortar Site x 3 (destroyed),	570880	183210	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
69	Site of Military Feature	SMR 10315, MEX31856	Pillbox (destroyed),	570750	183000	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
70	Site of Military Feature	SMR 10317, MEX31858	Road Barrier (destroyed).	570910	183080	Low	Medium	Visual: No direct impact Permanent: No direct effect from pipeline installation	Monitoring during	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
							(lies over 100m from the pipeline route)		construction	
71	Archaeological Investigation	NMR 417011, 656640;SMR 7246,7247, MEX23681, MEX23682	Palaeolithic flake, a scraper and three flakes of Neolithic or Bronze Age date were found during the construction of Corringham by pass in 1970.	570950	183150	Low	Medium (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
72	Site of military Feature	SMR 10318, MEX31859	Pillbox (destroyed),	570950	183130	Low	Medium (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
73	Site of Military Feature	SMR 10319, 10320, ME31860,ME X31861	Road Barrier and Spigot Mortar Site (destroyed), Lies within conservation area.	571020	183170	Low	Medium (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
74	Find spot	NMR 417006,41700 8, 622013; SMR 7100; 7101, MEX23295, MEX23300	Discoveries at this location include: Probable Roman burial with beaker found by chance in 1959; Late Bronze Age Briquetage (salt-production); Undated prehistoric (?Iron Age) pottery retrieved during observation of construction of a barn in 1974-5. Lies within conservation area.	571000	183300	High	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
75	Find spot	SMR 7134, MEX23441	A number of undated prehistoric worked flints (possible Mesolithic/Neolithic date) found by chance at this location before 1987.	571360	183390	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
76	Find spot	SMR 7135, 7137, MEX23442, MEX23444	Mesolithic and Neolithic flints and Roman pottery and tile found by chance at this location before 1987.	571450	183460	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
77	Find spot	SMR 7133, 7136, MEX23440, MEX23443	Roman pottery and tile found by chance at this location before 1987.	571550	183520	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
81	Earthworks	SMR 14770,	Series of rectangular ponds.	571800	183500	Low	Negligible	Visual: No direct impact	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
		MEX40117	Possible oyster pits or site of clay pits of former brick and tile works.				(lies over 100m from the pipeline route)	Permanent: No direct effect from pipeline installation		
88	Archaeological Investigation	NMR 658715	Thurrock Museum carried out an archaeological watching brief in 1991, which revealed a Roman saltern	572400	183600	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
89	Building	SMR 7159	Site of house noted on SMR. No further information. Related to adjacent Corringham Light Railway?	572380	183200	Low	Low (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	Monitoring during construction	Insignificant
90	Building	SMR 7160	Site of iron latch noted on SMR. No further information.	572980	183100	Low	Low (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
91	Site of military Feature	SMR 14766, MEX40109	Gun emplacement	572600	183100	Low	Low (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
92	Site of military Feature	SMR 14765, MEX40108	Gun emplacement	572700	183000	Low	High (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
93	Site of military Feature	SMR 14764, MEX40106	Gun emplacement, anti-aircraft battery	572900	183100	Low	High (lies within 50m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
94	Earthworks	SMR 17277	Earthworks of four probable bomb craters visible on air photographs. Possibly associated with non-military explosive factory at Kynochtown.	573300	183000	Low	Low (lies within 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
95	Site of Building	Chapman and Andre's map of 1771	Site of Button's Farm, shown on Chapman and Andre's map of 1771. Named 'Reedham'' on the OS 1st edition 6" map (surveyed 1863). The building is shown on	573064	182574	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
			maps up to 1960. It is not shown in 1968 and was presumabl.y destroyed between 1960-1968.							
104	Site of military Feature	SMR 14771, MEX40120	Site of W.W.II anti-aircraft ditches visible on air photographs.	573500	182300	Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
110	Site of Military Feature	SMR 14763	Site of W.W.II anti-aircraft ditches visible on air photographs.	572600	182900	Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	Monitoring during construction	Insignificant
128	DoE List of Buildings of Architectural or Historical Interest	SMR 35298, MEX1010704	The vicarage. House	568486	181144	High	See Table 4		See Table 4	
129	DoE List of Buildings of Architectural or Historical Interest	SMR 35297, MEX1010703	Church of St John the Baptist, Mucking. Church	568532	181181	Very high	See Table 4 (lies over 100m from the pipeline route)		See Table 4	
130	DoE List of Buildings of Architectural or Historical Interest	SMR 35299, MEX1010705	Mucking Hall. Timber Framed House	568522	181056	High	See Table 4		See Table 4	
151	DoE List of Buildings of Architectural or Historical Interest	SMR35219, MEX1010625	1 and 2 Herd Lane. Thatched House.	571139	183560	High	See Table 4		See Table 4	
153	DoE List of Buildings of Architectural or Historical Interest	SMR 35185, MEX1010591	Rose Cottage. House.	570928	183440	High	See Table 4		See Table 4	
154	DoE List of Buildings of Architectural or Historical Interest	SMR 35343, MEX1010752	Bush House. Timber Framed House	570925	183380	High	See Table 4		See Table 4	

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
155	DoE List of Buildings of Architectural or Historical Interest	SMR 35344, MEX1010753	Fearings Farmhouse. Timber Framed House	570937	183347	High	See Table 4		See Table 4	
156	DoE List of Buildings of Architectural or Historical Interest	SMR 35186, MEX1010592	Bell House. Timber Framed House	570978	183366	High	See Table 4		See Table 4	
157	DoE List of Buildings of Architectural or Historical Interest	SMR 35187, MEX1010593	Bull Inn. Inn	571000	183336	High	See Table 4		See Table 4	
158	DoE List of Buildings of Architectural or Historical Interest	SMR 35184, MEX1010590	Church of St Mary, Corringham. Church.	570985	183290	Very high	See Table 4		See Table 4	
159	DoE List of Buildings of Architectural or Historical Interest	SMR 35189, MEX1010595	Corringham Hall. House.	571044	183228	High	See Table 4		See Table 4	
160	DoE List of Buildings of Architectural or Historical Interest	SMR 35188, MEX1010594	Hall Farm Cottages. Timber Framed House	571003	183321	High	See Table 4		See Table 4	
161	DoE List of Buildings of Architectural or Historical Interest	SMR 35361, MEX1010771	Old Hall. House	570704	183015	High	See Table 4		See Table 4	
162	DoE List of Buildings of Architectural or Historical Interest	SMR 35289, MEX1010695	Black weatherboarded barn at Old Garlands Farm. Timber Framed House.	570355	182559	High	See Table 4		See Table 4	
163	DoE List of Buildings of Architectural or Historical	SMR 35250, MEX1010656	Great Garlands Farmhouse with stable to the north-west. House, Stable	570367	182403	High	See Table 4		See Table 4	

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
	Interest									
164	Cropmarks	Vertical air photograph RAF 58/720 Fr.5030 06-JUN-1951 NMR Lib No.3436; Stanford-le-Hope Tithe Map. Updated ECC 2011	Linear and rectilinear cropmarks visible on vertical air photograph taken in 1951. Tithe Award lists the field as 'Mill Field' but shows no structures. Possible site of windmill? New coverage obtained by ECC and plotted for this EIA. Cropmark morphology suggests prehistoric/ Roman date?	569990	181748	High	Low (northern edge of area lies within 100m from the pipeline route)	Visual: No permanent impact Permanent: Probable direct effect from pipeline installation	The route is chosen to avoid major cropmark concentrations.	Uncertain - likely to be minor adverse
165	Cropmarks	NMR specialist air photograph TQ 7082/7	Rectilinear and linear cropmarks visible on specialist air photograph taken in 1979. Identified by OAU. Not plotted by NMP. Uncertain if archaeological. Not shown on 2011 update by ECC for this EIA.	570368	182284	High	Low (lies within 50m from the pipeline route)	Visual: No direct impact Permanent: Potential effect from pipeline installation.	The route is chosen to avoid major cropmark concentrations.	Uncertain - likely to be minor adverse
166	Earthworks	OAU site visit and Vertical air photograph MAL/83001 Fr. 124 02-Jan-1983 NMR Lib No. 7809	Flat area of reclaimed marshland at the foot of the Terrace noted on OAU site visit. Flat area is partly enclosed on southern side by a sea wall c. 2- 3 m high (marked on OS maps). 'Humps and bumps' of possible earthworks visible at this location.	570768	182278	Medium	Negligible (lies within 50m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	Excavate or preserve in situ	Insignificant
167	Cropmarks	Vertical air photograph RAF 58/647 Fr. 5007 23-APR-1951 NMR Lilb No. 3372	Curvilinear cropmarks of two possible ring-ditches visible on vertical air photograph taken in 1951. Identified by OAU. Not plotted by NMP. Not shown on 2011 update by ECC for this EIA.	573130	183308	High	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	The route is chosen to avoid major cropmark concentrations.	Insignificant
168	Cropmarks	Vertical air photograph MAL/76055 Fr.	Rectilinear and linear cropmarks visible on vertical air photograph taken in 1976.	570455	182921	Medium	Negligible (lies over 100m	Visual: No direct impact Permanent: No direct effect from pipeline installation	The route is chosen to avoid major cropmark	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
		78 30-JUN-1976 NMR Lib No. 7387 Updated by ECC 2011	 New coverage obtained by ECC and plotted for this EIA.				from the pipeline route)		concentrations.	
169	Cropmarks	NMR specialist air photographs TQ7082/5 and TQ7082/6 22-JUL-1974 Updated by ECC 2011	Faint rectilinear and linear cropmarks visible on specialist air photographs taken in 1974. New coverage obtained by ECC and plotted for this EIA.	570242	182474	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
170	Earthworks	Noted on OAU site visit	Possible earthwork bank, c. 12 m in long by c. 1.2 m wide, noted in field of unharvested barley during site visit. Possibly part of old field boundary.	569512	181921	Medium	Low (lies within 100m from the pipeline route)	Visual: No permanent visual impact Permanent: Probable direct effect from pipeline installation	SMS excavation	Insignificant
171	Cropmarks	Identified on OAU site visit.	Sub-square cropmark c.8 m along each side. Site of possible structure. Not shown on 2011 update by ECC for this EIA.	570181	181764	Medium	Low (lies over 100m from the pipeline route)	Visual: No permanent visual impact Permanent: No direct effect from pipeline installation	None	Insignificant
172	Historic map evidence	Identified on OAU site visit.	Sunken lane. Possible medieval or post-medieval date.	570549	182387	Medium	Low (lies within 50m from the pipeline route)	Visual: Minor adverse Permanent: Potential effect from pipeline installation	SMS excavation	Insignificant
173	Earthworks	Identified on OAU site visit.	Two parallel earthwork banks c. 5 m long by 0.5 m wide, identified on OAU site visit. Nature uncertain.	569947	182453	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
174	Earthworks	Identified on OAU site visit.	Linear earthwork of possible ?raised trackway aligned south-west to north-east.	570320	183061	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
175	Earthworks	Identified on OAU site visit.	Earthwork bank c. 20 m long by c. 1.8 m wide, visible within barley crop, identified on OAU site visit. Aligned north-east to south-west. Purpose unknown.	570335	182881	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
176	Cropmarks	Identified on OAU site visit.	Curvilinear parallel grassmarks visible within unharvested barley crop, identified on OAU site visit.. Possibly an enclosure to the north-west of Old Hall. South eastern side c. 45m in length. Not shown on 2011 update by ECC for this EIA.	570658	183143	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
177	Site of Building	Sparkes (1965) Corringham Marshes.	Old Hall. Site of medieval manor first mentioned in 1476. Mentioned throughout 16th century and in 1607. The existing building here dates to the 18th century (OAU 161) and is possibly built on or near the site of the early manor house.	570680	182981	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct effect from pipeline installation	None	Insignificant
180	Site of Building	OAU site visit	OAU site visit noted a possible structure platform at this location. Square area c. 12 m on each side, with level top..	570615	182227	Medium	High (lies within 50m from the pipeline route)	Visual: No permanent impact Permanent: Potential direct impact from pipeline installation	Preserve in situ if possible; excavate and record if not	Insignificant
181	Earthworks	OAU site visit	OAU site visit noted the earthwork remains of a possible extension to the sea defences at this location.	571008	182372	Low	Negligible (lies over 100m from the pipeline route)	Visual: No permanent impact Permanent: Potential direct impact from pipeline installation	Preserve in situ if possible; excavate and record if not	Insignificant
182	Earthworks	OAU site visit.	OAU site visit identified a c. 20 m long by 1.2 m wide earthwork bank at this location. Possible former field boundary.	570054	182307	Medium	Medium (lies within 100m from the pipeline route)	Visitls: No permanent impact Permanent: Potential direct impact from pipeline installation	Preserve in situ if possible; excavate and record if not	Minor adverse
183	Site of Building	OAU site visit.	OAU site visit noted that dismantled railway survives as a 1.8 m high enbankment at this location.	572336	183093	Low	Medium (lies within 100m from the pipeline route)	Visual: No direct impact Permanent: Potential direct impact from pipeline installation	Preserve in situ if possible; excavate and record if not	Minor adverse
184	Site of Building	mapping	Tithe Award lists field name as 'Saw Pit Field'. Possible site of	570521	182171	Low	Medium	Visual: No permanent impact Permanent: Potential direct impact from pipeline	Preserve in situ if possible;	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
			post-medieval saw pit. No structures/pits are shown.				(lies within 50m from the pipeline route)	installation	excavate and record if not	
185	Site of Building	OAU site visit.	Tithe Award lists field as 'Stone Field' . No structures are shown. The name may possibly refer to the remains of an earlier stone structure, possible identified on the OAU site visit (OAU 175).	570292	182873	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct effect from pipeline installation	None	Insignificant
203	Building	1922 edition 25 inch OS map (surveyed 1915); Kay 1999	Oil tank farm of London and Thames Haven Oil Wharves Ltd (LATHOL) on land purchased in 1902 from London & North Western Railway. 20 tanks shown on 25 inch OS map of 1915. Tanks set on raised platform	573541	181684	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
206	Building	OS 1915 map; Kay 1999	Homelight oil tank farm, part of enlarged London and Thames Haven Oil Wharves Ltd plant on land purchased in 1902 from London and North Western Railway. 8 tanks shown on 1915 OS map.	573262	181660	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
208	Building	Kay 1999	Site of small, original London and Thames Haven Oil Wharves Ltd refinery constructed in 1914 on newly-purchased land north of railway but south of Rugward Fleet.	573153	181734	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
210	Building	Kay 1999; Sparkes 1965; Scott 1981; OS 1922; OS 1938	Light railway established in late 1890s and opened in 1901 to transport employees from villages of Corringham and Fobbing to new Kynoch explosives factory. Additional short branch constructed to link CLR with main line Thames Haven railway to the south.	573387	182451	Medium	High (lies within 50m from the pipeline route)	Visual: Minor permanent visual impact Permanent: No direct impact from pipeline installation	Negligible	Insignificant
211	Building	Kay 1999; OS 1922 (surv 1915)	Reedham west tank farm. Part of LATHOL oil plant constructed on land purchased in c.1914 from Oil mill farm. Shown on 1915 OS map (25 inch) with 18 tanks.	573064	181857	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
212	Building	Kay 1999; OS 1922 (surv 1915)	Reedham east tank farm. Part of LATHOL oil plant constructed on land purchased in c.1914 from Oil Mill Farm. 1922 OS map (surv 1915) shows 21 tanks set on raised platform.	573284	181927	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
216	Building	Chapman and Andre's Map of 1771 and OS maps	Oil Mill Farm. Chapman and Andre's Map of 1771 shows 'Island Mill' comprising two buildings and an enclosed area at the marshland edge, beside the inter-tidal mudflats of Shell Haven Creek. Sales Particulars of 1779 refer to 'Oil Mill Farm'. The Isl	573852	182498	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
240	Find spot	SMR 5258, MEX18147	A new school site on the eastern side of Butts Lane was visited to monitor surface scraping in 1977. Fragments of 19th century pot were found as well as modern drainage pipes. Not certain that there was nothing earlier was there, but it is assumed that	568150	181700	Low	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
241	Archaeological Investigation	SMR 5143, MEX17720	Ditch intersection cut by gas pipeline trench. Apparently three ditches, only one had finds - small sherds of flint-gritted pottery. Early Iron Age, low in fill. A 4th ditch and possible pit were seen on the east side of the trench. Ditches were 6ft wide	567820	180960	Medium	Medium (lies within 100m from the pipeline route)	Visual: No direct impact Permanent: Probably unavoidable impact from pipeline installation.	Preserve in situ if possible. If not, excavate and record	Minor adverse
242	Find spot	SMR 5144, MEX17724	RB pottery. Surface scatter.	567800	181000	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
243	Find spot	SMR 5145, MEX17728	I / A pottery, surface scatter.	567800	181000	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
244	Find spot	SMR 5146, MEX17729	Early medieval pottery	567700	181000	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignifican
249	Find spot	SMR 13833, MEX38140	Circular Enclosure (Mucking North Ring)	567550	181220	Very High	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
250	Archaeological Investigation	NMR 1302255, 639044, SMR 13834, MEX38148	A Late Bronze Age circular enclosure at Mucking, known as the North Ring in order to distinguish it from a similar and contemporary site circa 1 kilometre to the south (TQ 68 SE 43). The enclosure was excavated in 1978 in advance of gravel quarrying, whi	567550	181220	Very high	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
251	Settlement	SMR 13835, MEX 38150	Settlement primarily Medieval, *grubenhaus.*	567550	181120	Very high	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
273	Historic map evidence	SMR 1862	Post-medieval gravel pit and disturbances	570449	182142	Low	High (lies within 50m from the pipeline route)	Visual: site will be obliquely obscured by overhead cables Permanent: Potential effect from pipeline installation	None	Insignificant
282	Find spot	NMR 1145511	Palaeolithic flint implements found - 4 hand axes, 1 retouched flake and 9 flakes. No specific provenance, found in a pit at a depth of 2m.	569797	182494	High	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
283	Find spot	NMR 414090	Palaeolithic implements found c. 1968. In a gravel pit	570577	181848	Medium	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
286	Find spot	NMR 414098	IA/RB pottery.	567800	181000	Medium	Medium (lies within 100m from the pipeline	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
							route)			
295	Archaeological Investigation	NMR 1336809	Pre-hist. Pit cluster. Bronze Age ring-ditch, med farm and quarry, and a site of uncertain date. Watching brief 1999.	567500	181300	High	Negligible (lies over 100m from the pipeline route)	Visual: No direct impact Permanent: No direct impact from pipeline installation	None	Insignificant
309	DoE List of Buildings of Architectural or Historical Interest	SMR 35298, MEX1010704	The Vicarage. House.	568486	181144	High	See Table 4		See Table 4	
363	Archaeological Investigation	SMR 19495, MEX1034103	Kiln	570450	182300	Medium	High (lies within 50m from the pipeline route)	Visual: N/A Permanent: Potential effect from pipeline installation.	Preserve in situ if possible. If not excavate and record	Minor adverse
364	Site of Building	SMR 19497, MEX1034106	Enclosure	570570	182340	Medium	High (lies within 50m from the pipeline route)	Visual: N/A Permanent: Potential effect from pipeline installation	Preserve in situ if possible. If not excavate and record	Minor adverse
7001	Find spot	London Gateway Intertidal Survey	Section of clay tobacco pipe with broken bowl – find retained	570379	181304	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct impact from pipeline installation	None	Insignificant
7002	Find spot	London Gateway Intertidal Survey	Romano-British pottery sherd – find retained	570418	181320	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct impact from pipeline installation	None	Insignificant
7003	Inter-tidal feature	London Gateway Intertidal Survey	Two lines of piles and associated rotted rope and steel cable.	570319	181221	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct impact from pipeline installation	None	Insignificant
7009	Inter-tidal feature	London Gateway Intertidal Survey	Peat exposure - evidence that it has been driven over by motorbikes	570322	181226	Low	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct impact from pipeline installation	None	Insignificant
7010	Inter-tidal feature	London Gateway Intertidal	Small row of stakes or frames angled down to the east.	570326	181268	Medium	Negligible (lies over 100m	Visual: N/A Permanent: No direct impact from pipeline installation	None	Insignificant

No.	Receptor Type	Sources	Description	OS East'g	OS North'g	Importance of receptor	Magnitude of Change	Process of Change	Mitigation	Residual Effect
		Survey					from the pipeline route)			
7011	Inter-tidal feature	London Gateway Intertidal Survey	Arc of vertical wooden posts - possible component of former fishtrap	570350	181195	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct impact from pipeline installation	None	Insignificant
7017	Inter-tidal feature	London Gateway Intertidal Survey	5 vertical stakes and 1 whale within mud	570591	181432	Medium	Negligible (lies over 100m from the pipeline route)	Visual: N/A Permanent: No direct impact from pipeline installation	None	Insignificant

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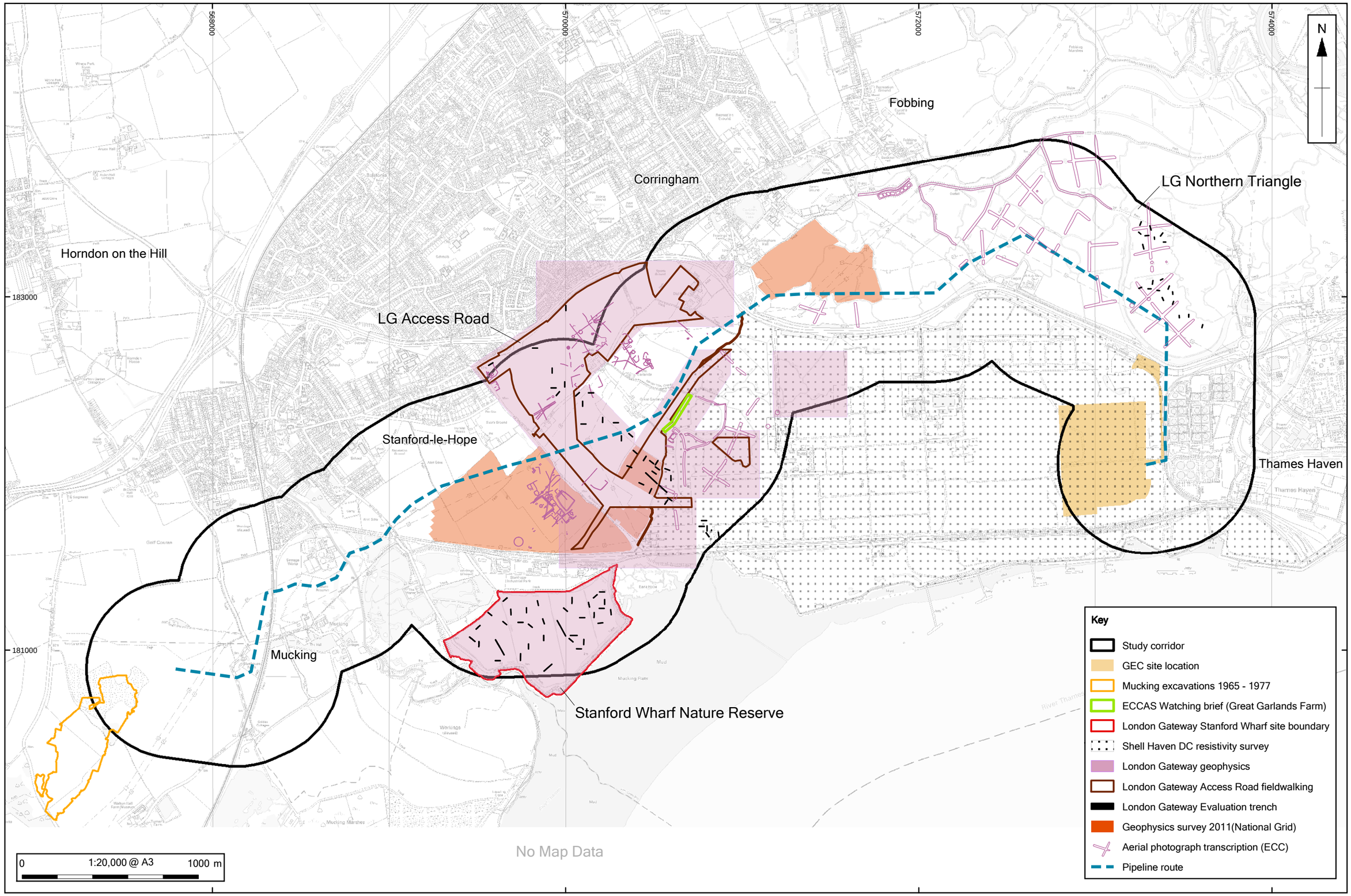

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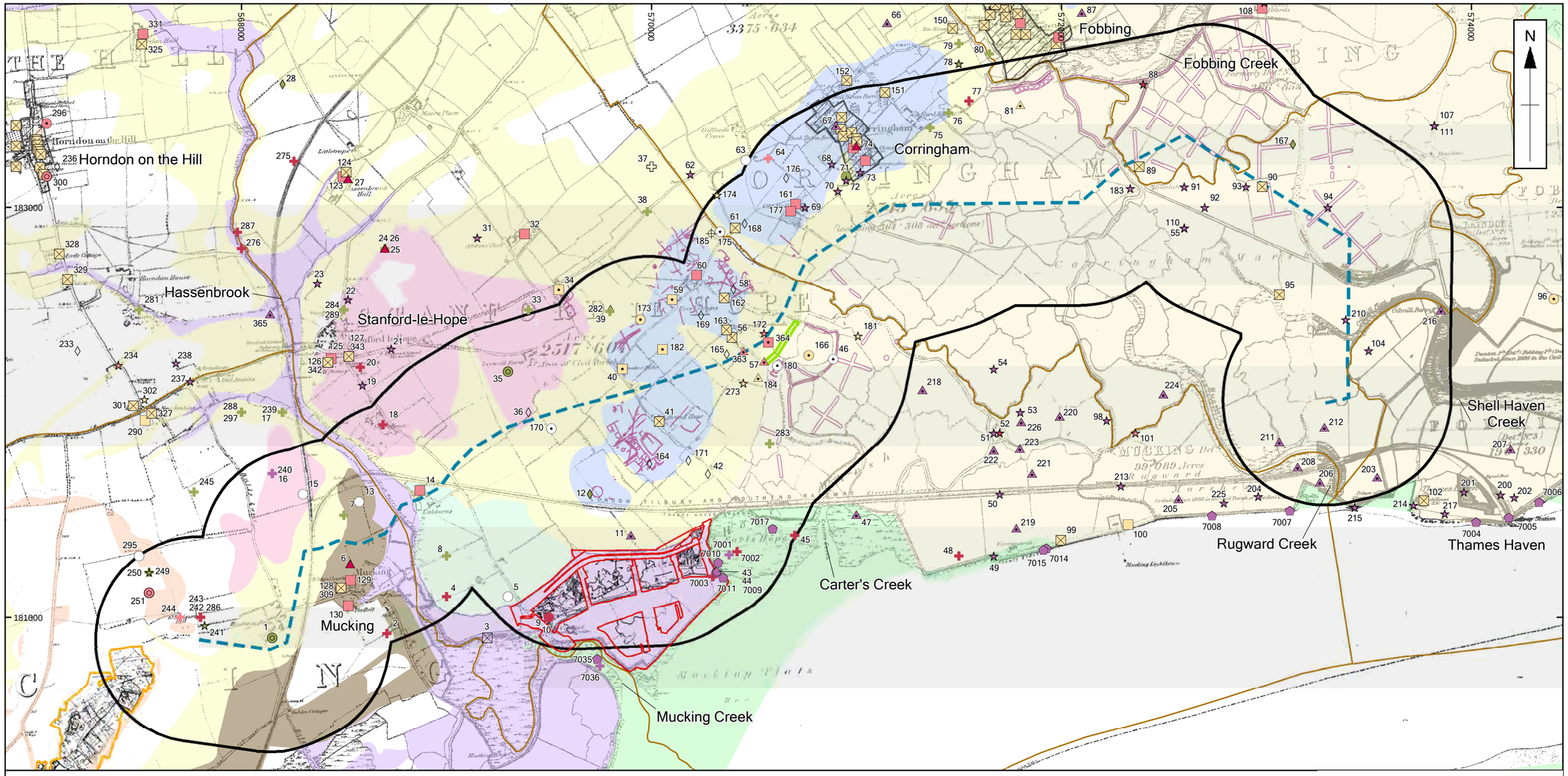
Figure 1: The pipeline route in relation to previous excavations, existing non-intrusive survey and trenching coverage



Key

- Study corridor
- Parish boundary
- Aerial photo transcription (ECC)
- Conservation area
- Mucking excavations 1965 - 1977
- ECCAS Watching brief (Great Garlands Farm)
- London Gateway Stanford Wharf site boundary
- Pipeline route

Colour Phasing

- Prehistoric
- Roman
- Medieval
- Post-medieval
- Modern
- Undated/ Various

HER symbols

- Burial
- Cropmarks
- Monument
- Earthwork
- Enclosure
- Find spot
- Historic building

- Industrial site
- Inter-tidal survey feature
- Archaeological investigation
- Building
- Scheduled Ancient Monument
- Settlement
- Uncertain
- Archaeological site

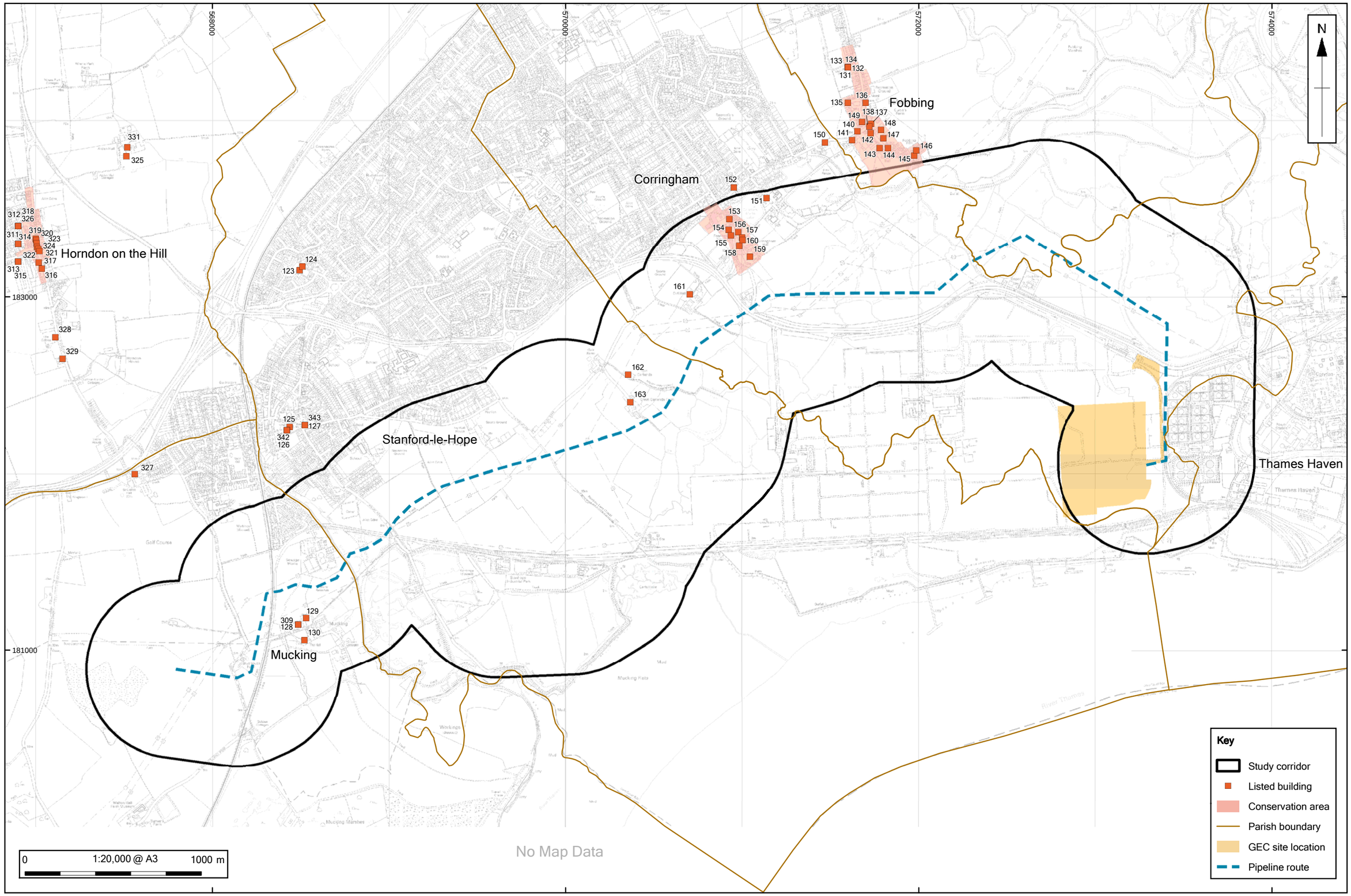
Drift Geology

- Alluvium (Zone 2)
- Beach and tidal flat deposit (undifferentiated)
- Head (undifferentiated) (Zone 3)
- Lynch Hill gravel formation (Zone 4)
- River Terrace deposit 2 (Zone 4)
- River Terrace deposit 3 (Zone 4)
- Taplow gravel formation (Zone 4)
- Tidal flat deposit (Zone 1)

NB. Refer to Fig.1 for gazetteer numbers within the Conservation Areas.

0 1:20,000 @ A3 1000 m

Figure 2: The pipeline route in relation to baseline archaeological and historical landscape data, overlaid on a 1st Edition OS map



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Checked by: GJ & MW 16.05.2011

Figure 3: The pipeline route in relation to listed buildings and conservation areas

APPENDIX E

UPDATE TO MARCH 2011 ES SECTION 18

E UPDATE TO MARCH 2011 ES SECTION 18

Introduction

The Further Information, in respect of the March 2011 ES Section 18 is provided in:

Appendix E.1 – Updated March 2011 ES Section 18

APPENDIX E.1 –UPDATED MARCH 2011 ES SECTION 18

18 INDIRECT / SECONDARY AND CUMULATIVE IMPACTS

18.1 Introduction

18.1.1 This Section assesses the likely indirect / secondary and cumulative impacts associated with the development of the gas pipeline and AGI. In undertaking this assessment, this Section draws on the assessment of direct impacts provided in ES Sections 9 to 16, in addition to information relating to other developments in the area.

18.1.2 Indirect / secondary impacts are impacts on the environment which are not a direct consequence of a proposed development, and are often produced far away from the site of a proposed development (e.g. when they are a consequence of an ancillary activity rather than a main development activity).

18.1.3 Cumulative impacts can be either:

- ***Type 1 Cumulative Impacts; or***

  These are combined effects of different types of impact on a single receptor. For example: noise, dust and visual impacts resulting from construction and operation of the development and other planned developments.

- ***Type 2 Cumulative Impacts.***

  These are impacts from other planned developments (considered together with the proposed development) which individually may be insignificant, but when considered together could form a significant cumulative impact. For example: combined traffic impacts from two or more proposed developments.

18.1.4 It should be noted that there is an inherent uncertainty in the range of cumulative impacts which may arise, although the assessment in this Section seeks to identify the likely significant effects in a qualitative manner.

18.1.5 For each of the identified indirect / secondary or cumulative impacts, an assessment has been undertaken to determine when the impact is significant or not significant based on the methodologies outlined in this ES.

18.1.6 In addition and as noted previously in the ES, GEC will be designed so as to be CCR, with space made available in the design to allow for the retrofitting of a carbon capture plant in the future. This is discussed further in the CCR Feasibility Study which has been submitted in support of the Section 36 Consent application for GEC (February 2010) (Available at http://www.gatewayenergycentre.co.uk/).

18.1.7 Based on this information this Section also assesses the likely significant environmental effects in respect of CCR and Carbon Capture and Storage (CCS). However, due to the likely delay in the implementation of CCS there is a greater level of uncertainty associated with the development details. Details which are known at this stage are set out in the CCR Feasibility Study.

18.1.8 In terms of Guidance on the assessment of CCR / CCS, the DECC November 2009 CCR Guidance[1] states that the reasons that an EIA is not required for CCS at the CCR are because

"*Given the inevitable uncertainty about the precise route* [for the CO_2 pipeline] *and what might by CCS stage in the future be the safety and environmental requirements, we do not envisage any formal environmental impact assessment (EIA) being*

[1] *Carbon Capture Readiness (CCR): A Guidance Note for Section 36 Electricity Act 1989 Consent Applications.* URN 09D/810, DECC, November 2009.

undertaken. This will however need to be done when an operator wishes to fit CCS to the plant".

18.2 Description of Developments Considered

18.2.1 The developments considered within this Section are:

- GEC;
- The new underground cable / over ground transmission line / combination of both to connect GEC to the HV National Grid System (electrical connection) together with the associated National Grid Sub-station and connection to the existing Rayleigh to Tilbury overhead line (National Grid Infrastructure) ;
- Potential CHP connections associated with the development of GEC; and
- The LG Development.

18.2.2 It should be noted that as the preferred routes of the infrastructure connections (electrical connection and potential CHP connection) are still to be confirmed (and are the subject of ongoing assessment), it is not possible to detail the likely significant environmental impacts in a specific manner. However, information relating to the likely significant environmental impacts which may arise is provided so as to allow an assessment to be undertaken.

18.2.3 Additionally, consents (in the form of wayleaves / leases / etc) will be sought from every land owner / occupier of land crossed by the infrastructure connections. This will permit the developer to enter onto land in order to construct, operate and maintain the infrastructure connections.

GEC

Information on GEC is provided in Section 4 of the ES which accompanied the Section 36 Consent application (Available at http://www.gatewayenergycentre.co.uk/). Brief details are provided in Section 4.2 of this ES.

Electrical Connection

18.2.4 Details of the most likely connection options are provided in Section 4.3. It is noted that these routes and substation locations are the subject of on going studies.

18.2.5 In addition to the information presented in March 2011 ES Section 4.3, further feasibility work undertaken has resulted in the identification (by National Grid) of two potential sub-station locations, with each sub-station having two associated electrical connection route options. All routes exit the GEC site to the east and then turn northwards following the route of the agreed easement with the LG Development. In all cases, this section will be via an underground cable.

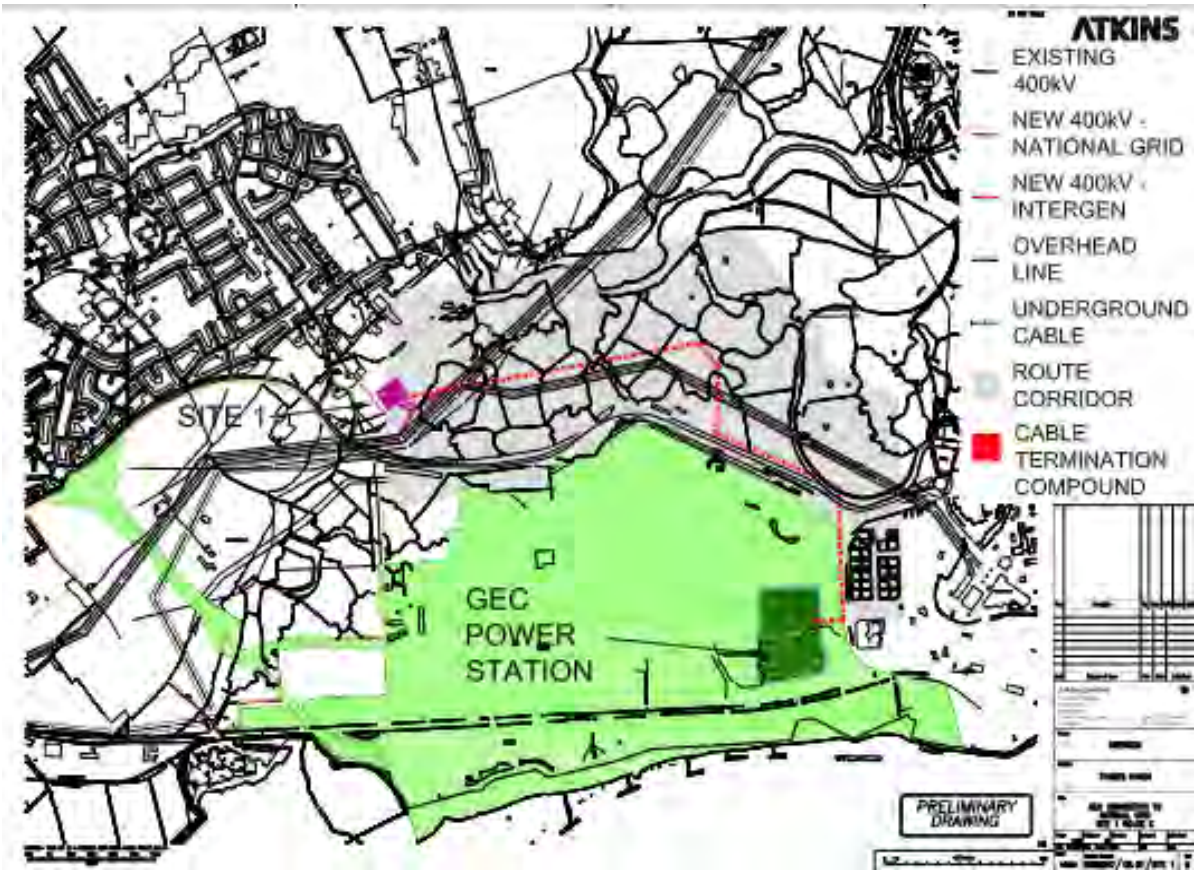
18.2.6 The four potential electrical connection route options are shown in Inserts 18.1 to 18.4.

Routes to National Grid Sub-Station Option 1

Underground Cable Route Option (NG SS1 – UGC)

18.2.7 The underground cable option to National Grid Sub-station Option 1 is shown in Insert 18.1.

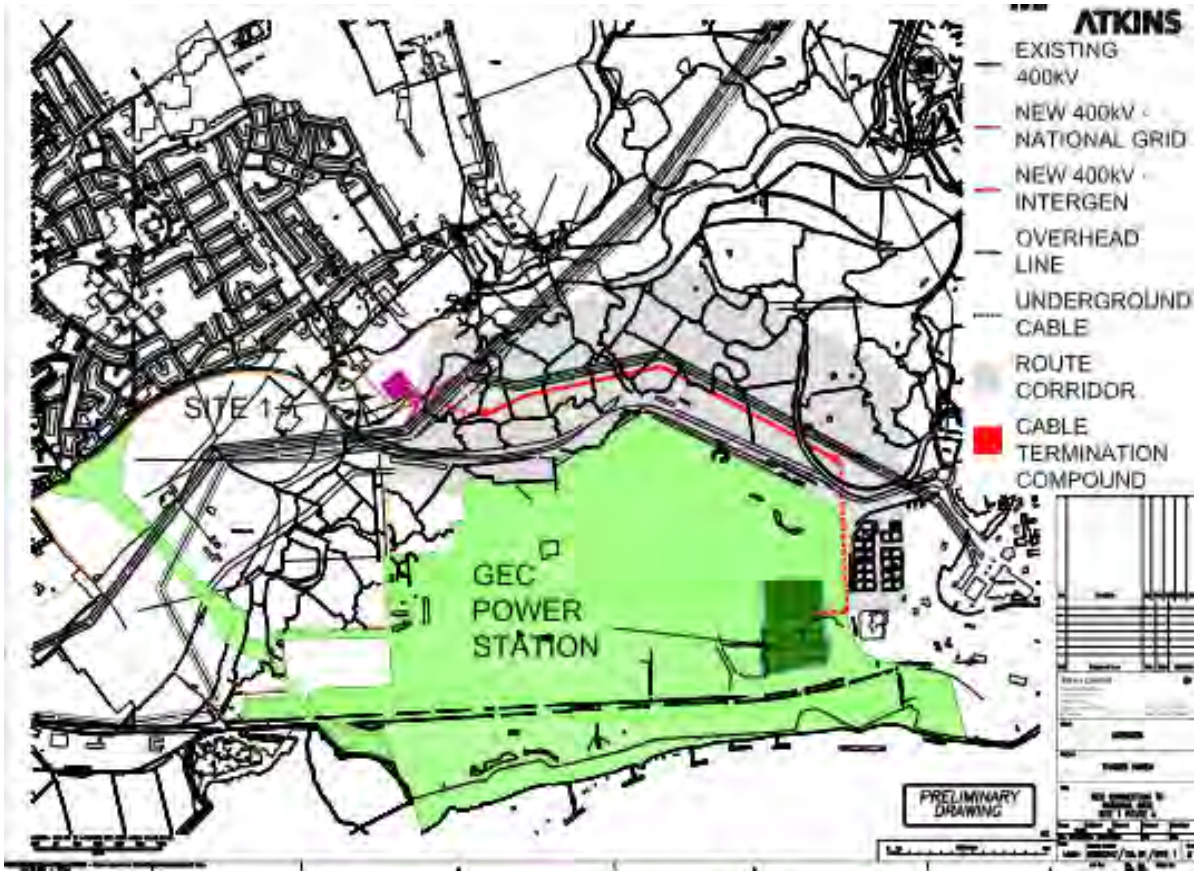
INSERT 18.1: UNDERGROUND CABLE ROUTE OPTION TO NATIONAL GRID SUB-STATION OPTION 1



Overhead Line Route Option (NG SS1 – OHL)

18.2.8 The overhead line option to National Grid Sub-station Option 1 is shown in Insert 18.2.

INSERT 18.2: OVERHEAD LINE ROUTE OPTION TO NATIONAL GRID SUB-STATION OPTION 1

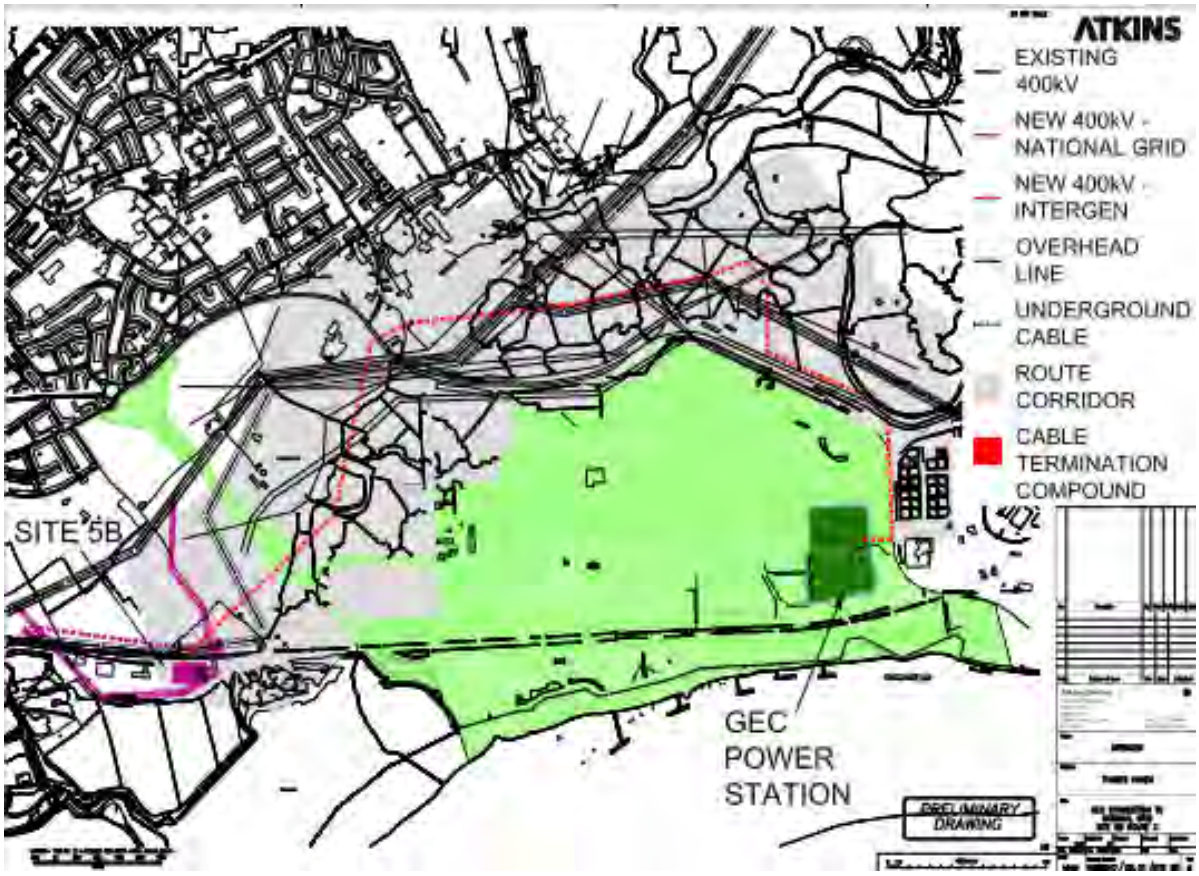


Routes to National Grid Sub-Station Option 5B

Underground Cable Route Option (NG SS5B – UGC)

18.2.9 The underground cable option to National Grid Sub-station Option 5B is shown in Insert 18.3.

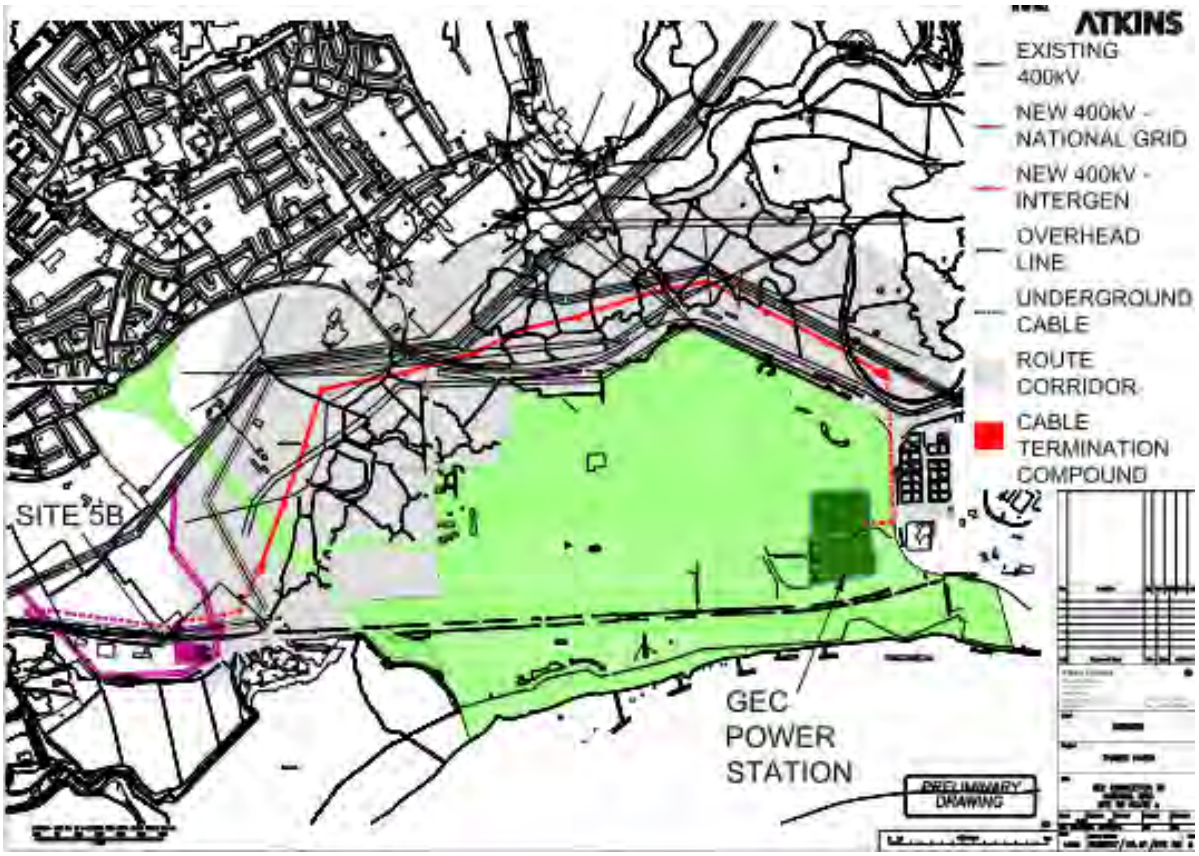
INSERT 18.3: UNDERGROUND CABLE ROUTE OPTION TO NATIONAL GRID SUB-STATION OPTION 5B



Overhead Line Route Option (NG SS5B – OHL)

18.2.10 The overhead line option to National Grid Sub-station Option 5B is shown in Insert 18.4.

INSERT 18.4: OVERHEAD LINE ROUTE OPTION TO NATIONAL GRID SUB-STATION OPTION 5B



18.2.11 In terms of this Section, for the purposes of assessment, the likely significant indirect / secondary and cumulative impacts are discussed for both an over ground or underground electricity connection noting that a number of impacts will differ depending on the option selected. For example, if an over ground electrical connection is selected there are likely to be more adverse landscape and visual impacts during operation. Conversely, if an underground electrical connection is selected, there are likely to be more adverse archaeology / cultural heritage impacts during construction.

Construction of the Electrical Connection

Over ground Electrical Connection

18.2.12 In order to construct the over ground electrical connection, it will be necessary to construct new access tracks to each tower site. Accordingly, access for construction would be gained wherever feasible from existing main roads along the route of the over ground transmission line, with tracks being provided (wherever necessary) from the road network to the tower sites. The majority of the new tracks that would be needed would be temporary. However, there is the possibility that some may be retained.

18.2.13 Following construction of the access tracks, the foundations for each tower would be installed. At winch sites (tower sites which would be used for stringing the conductors between towers) a larger working area could be required on each side of the tower.

18.2.14 Excavations would be undertaken for each leg of the tower. The dimensions of the excavation would vary depending on the tower type constructed. A typical leg excavation would be between 64 to 125 m^3. Some rock breaking might be needed to achieve the required depths for the tower foundations depending on the ground conditions below. Additionally, for an over ground electrical connection cable sealing end compounds will be required. The proposed locations of the cable sealing end compounds are shown on Inserts 18.2 and 18.4. These will also likely require excavations.

18.2.15 Once the concrete has been poured and set, the excavations would be back-filled using the original materials, if suitable, and compacted in layers. Steelwork for each tower would be delivered to each tower location. The towers would be part assembled at ground level and the tower would be erected using a crane.

18.2.16 Once a number of sections of towers have been erected, conductors would be strung between them using a winch at one end of the section and a tensioner at the other end. First, a pilot wire would be flown by a helicopter through the section between the winch and the tensioner, placed in blocks on the suspension and tension towers and connected around the winch and tensioner at either end. Using the winch to pull the pilot wires, the conductor would then be drawn through the section under constant tension, allowing the conductor to be controlled without touching the ground.

Underground Electrical Connection

18.2.17 It should be noted that should an underground electrical connection route option be used construction methods would be similar to those for the gas connection.

National Grid Sub-Station

18.2.18 Information on the proposed National Grid Infrastructure construction / operation can be found in their Scoping Report. This is available at:

http://infrastructure.independent.gov.uk/projects/eastern/east-thurrock-connection-project/documentation/?ipcdocsec=folder

CHP Infrastructure Connections

18.2.19 GEC may also require the installation of an on site CHP plant and off site CHP connections to the LG Development / other customers in the area. Further details on the CHP opportunities are presented in the CHP Assessment and the Supplementary CHP Assessment (Available at http://www.gatewayenergycentre.co.uk/).

18.2.20 The results of the two assessments are that the provision of CHP from a CCGT specifically designed for such a purpose would be technically feasible. The installation and operation of CHP infrastructure could therefore take place as part of the construction of GEC, and therefore assessment of the potential impacts is covered by the original ES submitted to accompany the Section 36 Consent application.

18.2.21 In terms of off site CHP infrastructure, it should be noted that the installation of these (e.g. installation of pipes) may fall to the CHP user, and also are considered similar to the impacts of installing / upgrading utility services. These types of works are not considered to have the potential for significant environmental effects within the LG Development, and therefore the off site CHP infrastructure works are excluded from this Section. The potential CHP infrastructure connections are therefore not considered further here.

The LG Development

18.2.22 GEC will be located on land within the LG Development. Details of the LG Development are provided in Section 4.5. A visualisation of the potential appearance and scale of the completed LG Development, including GEC, is available to view on:

http://www.londongateway.com/portal/page/portal/LONDON_GATEWAY/Home.

18.3 Developments Scoped Out of Assessment

Tilbury C CCGT

18.3.1 Tilbury C CCGT is located approximately 10 km south west of the GEC site. Information on the development is contained in the 'Environmental Impact Assessment Scoping Report – Proposed Tilbury C Combined Cycle Gas Turbine Power Station (RWE npower, July 2010)[2].

18.3.2 Tilbury C CCGT will have a main plant capacity of approximately 2000 MW. There may also be up to 400 MW of open cycle gas turbine (OCGT) capability. Tilbury CCGT is expected to achieve an efficiency of up to 59 per cent, in line with other new CCGT plants that are being developed with the higher efficiency the result of using latest proven technology coupled with direct sea cooling. The OCGT plant will have a lower efficiency.

18.3.3 Tilbury C CCGT will be built to Best Available Techniques (BAT) and will be designed such that it is Carbon Capture Ready (CCR), such that it is configured to allow for the installation of Carbon Capture and Storage (CCS) technology in the future when this becomes technically available and commercially feasible.

18.3.4 The proposal also includes:

- A new gas pipeline spur (approximately 3 km long) to connect Tilbury C to the existing NTaS Number 5 Feeder pipeline located to the east of the site; and,
- The removal of the overhead lines which connect the EDF Networks substation in the north west of the site to the existing Tilbury B Power Station and the installation of underground cables to replace them.

[2] The Tilbury C CCGT Scoping Study can be downloaded from:
http://infrastructure.independent.gov.uk/wp-content/uploads/2010/07/Tilbury-Scoping-Report.pdf

18.3.5 However it is noted that these proposals are at an early stage and an application is yet to be made. Indeed the EIA is yet to be developed. The application for Tilbury C CCGT is due to be made in Q1 of 20123.

18.3.6 As of 27 July 2011, RWE's website notes:

"*In early 2010, we announced that we had begun investigating the option of a new, combined cycle gas turbine (CCGT) power station at our site in Tilbury, Essex. Alongside this, we also applied for and secured the consents needed to convert the existing Tilbury Power Station to run on 100% biomass until its closure under the Large Combustion Plant Directive (LCPD) by the end of 2015.*

In early 2011, after carefully assessing the available options for the site, we made the decision to consider the possibility of re-permitting and re-consenting the existing Tilbury Power Station to enable it to continue to operate as a dedicated biomass plant beyond the LCPD limit. As a result, the CCGT development project has been reprioritised and put on hold for the time being."

18.3.7 Further information is available on:

(http://www.rwe.com/web/cms/en/657440/rwe-npower/about-us/our-businesses/new-power-stations/tilbury/)

18.3.8 Therefore Tilbury C CCGT is not considered to be committed development.

18.3.9 Tilbury C CCGT is therefore not considered further in this ES.

18.4 Indirect / Secondary Impact Assessment

18.4.1 The following sub-section identifies the main likely indirect / secondary impacts during the construction and operation of GEC and the electrical connection. It should be noted that indirect / secondary impacts have been considered on the basis that GEC would not operate without a gas connection and electrical connection. However, it could be more properly said that the gas connection (proposed gas pipeline and associated AGI) and electrical connections are indirect / secondary impacts of the development of GEC.

Indirect / Secondary Impacts – Construction

GEC

18.4.2 Table 18.1 summarises the likely indirect / secondary impacts of GEC.

Electrical Connection

18.4.3 Table 18.2 summarises the likely indirect / secondary impacts of the electrical connection (including the National Grid Infrastructure). It should be noted that the indirect / secondary impacts noted cover all four potential connections which have been described previously in Section 18.2 (Electrical Connection). However, distinctions are made where the impacts of an over ground electrical connection would differ from an underground electrical connection, or the impact of a longer route would differ from a short route.

18.4.4 It should be noted that an EIA has not yet been undertaken on the electrical connection (or the proposed National Grid Infrastructure). Therefore, the assessment is based on an understanding of the likely construction processes and assumptions on timing, duration and knowledge of baseline conditions.

[3] *http://infrastructure.independent.gov.uk/projects/eastern/tilbury-gas-fired-power-station/*

TABLE 18.1 – LIKELY IMPACTS OF THE CONSTRUCTION OF GEC

Impact Type	***Construction Impacts***	***Mitigation***	***Residual Effects***	***Means by which Mitigation will be Delivered***
Air Quality	During construction, there is the potential for impacts on air quality due to the nature of construction work (dust emissions arising from activities such as excavating / earth moving operations) and the additional traffic generated at this time.	Dust emissions will be managed and controlled through a Construction Environmental Management Plan (CEMP).	The residual impact is assessed as not significant.	CEMP.
Noise	During construction, there is the potential for noise impacts due to the nature of construction work (the use of noise generating plant) and the additional traffic generated at this time.	Construction plant and activities will be managed and controlled through a CEMP.	The residual impact is assessed as not significant.	CEMP.
Landscape and Visual	During construction, it is unlikely that there will be any impacts on Local Landscape Character due to construction. However, visual impacts will arise from the presence of cranes, machinery, excavations and temporary structures, etc.	Construction works will be screened by hoarding, where practical, to mitigate landscape and visual impacts near to sensitive receptors.	Although mitigation measures will reduce potential visual impacts, it is likely that significant adverse landscape and visual impacts will arise during the construction phase. These impacts will be temporary in nature, and as such the residual impact is assessed as not significant.	CEMP.
Ecology	Due to the nature of site, and the program of remediation being undertaken, there is limited potential for impacts on ecological receptors.	A full program of remediation is being undertaken. Habitat surveys and protected species surveys will be undertaken prior to construction works commencing on site. Measures to introduce biodiversity enhancements on and off site will be identified.	The residual impact is assessed as not significant.	Remediation to take place as part of the LG Development / CEMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Water Quality	There is the potential for impacts on controlled waters to arise.	This impact will be managed and controlled through a CEMP and drainage strategy. No untreated water will be allowed to drain to controlled waters.	The residual impact is assessed as not significant.	CEMP.
Geology and Land Contamination	Due to the location of the site, and the historical land uses, there is a high potential for contamination to be present on site. However, there is a program of remediation being undertaken such that there is limited potential for existing contamination to be present on site prior to construction. Contaminants (such as fuels and concrete) will be used on site. There is the potential for land contamination to occur as a result of spillages.	A full program of remediation is being undertaken. A risk assessment will be carried out prior to the commencement of construction. This will be managed and controlled through a CEMP. Procedures will be put in place to deal with any pollution spills.	The residual impact is assessed as not significant.	Remediation to take place as part of the LG Development / CEMP.
Traffic	There may be additional construction traffic in the form of HGVs and construction personnel vehicles.	Traffic will be managed and controlled through a Construction Transport Management Plan (CTMP).	The residual impact is assessed as not significant.	CEMP / CTMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Cultural Heritage	The cultural heritage in the area is well understood from the work undertaken for the LG Development. As such, the existence and whereabouts of any existing cultural heritage features which have the potential to be impacted upon are already well understood. A program of remediation being undertaken, and it is unlikely that there will be impacts on archaeological remains of significance during construction.	An assessment of the likelihood of archaeological remains of significance at the GEC site will be undertaken. If it is discovered that archaeological remains are present, an archaeological watching brief will be used during construction.	The residual impact is assessed as not significant.	CEMP.
Socio-Economics	Short term employment opportunities during the construction works.	The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	Residual positive impact, albeit short term.	None Required.
Safety	There are a number of safety considerations which need to be implemented such that GEC can be designed, built and tested (i.e. constructed) in such a way that its integrity is not comprised during its operational lifetime.	GEC will be designed and constructed in line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.	The residual impact is assessed as not significant.	Compliance with relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.
Health	During construction, there may be the potential for impacts on health due to air / dust emissions, noise and transport.	The aspects of the environment most likely to cause impacts on health (air / dust emissions, noise and transport) are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan (HMP).	The residual impact is assessed as not significant.	CEMP (for other aspects of the environment listed above) / HMP.

TABLE 18.2 – LIKELY IMPACTS OF THE ELECTRICAL CONNECTION CONSTRUCTION

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Air Quality	During construction, there is the potential for impacts on air quality due to the nature of construction work (dust emissions arising from activities such as excavating / earth moving operations) and the additional traffic generated at this time. For both an over ground electrical connection and an underground electrical connection impacts would be similar, as construction work (excavating / earth moving) would be undertaken at either the tower sites / cable sealing end compound locations (for the over ground cables) or along the working width (for the underground cables). Similar impacts are anticipated for the National Grid Infrastructure. For a longer electrical connection route, potential impacts on air quality may be experienced over a wider area.	Dust emissions will be managed and controlled through a CEMP.	The residual impact is assessed as not significant.	CEMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Noise	During construction, there is the potential for noise impacts due to the nature of construction work (the use of noise generating plant) and the additional traffic generated at this time. For both an over ground electrical connection and an underground electrical connection impacts would be similar, as construction work (using noise generating plant) would be undertaken at either the tower sites / cable sealing end compound locations (for the over ground cables) or along the working width (for the underground cables). Similar impacts are anticipated for the National Grid Infrastructure. For a longer electrical connection route, potential noise impacts may be experienced over a wider area.	Construction plant and activities will be managed and controlled through a CEMP.	Although all construction works will be undertaken in accordance with a CEMP, it is still likely that there may be minor, temporary local noise impacts at receptors located between 100 m and 300 m from the electrical connection route. The residual impact is assessed as not significant.	CEMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Landscape and Visual	Landscape impacts may arise on Local Landscape Character due to construction. Visual impacts will arise from the presence of cranes, machinery, excavations and temporary structures, etc. For both an over ground electrical connection and an underground electrical connection impacts would be similar, as construction work would be undertaken at either the tower sites / cable sealing end compound locations (for the over ground cables) or along the working width (for the underground cables). Similar impacts are anticipated for the National Grid Infrastructure. For a longer electrical connection route, potential landscape and visual impacts may be experienced over a wider area.	Construction works will be screened by hoarding, where practical, to mitigate landscape and visual impacts near to sensitive receptors.	Although mitigation measures will reduce landscape and visual impacts, and the magnitude of change would be minimized in areas where the electrical connection follows the existing over head transmission lines, it is likely that significant adverse landscape and visual impacts will arise during the construction phase. These impacts will be temporary in nature, and as such the residual impact is assessed as not significant.	CEMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Ecology	There is the potential for impacts on ecology to arise during the construction phase. For both an over ground electrical connection and an underground electrical connection impacts would be similar, as construction work would be undertaken at either the tower sites / cable sealing end compound locations (for the over ground cables) or along the working width (for the underground cables). Similar impacts are anticipated for the National Grid Infrastructure. For a longer electrical connection route, potential impacts on ecology may be experienced over a wider area.	Habitat surveys and protected species surveys will be undertaken prior to construction works commencing on site. Areas where protected species are known to occur or areas with the potential to support ecological habitat will be avoided where possible, and removal of habitat will not occur during the breeding season.	Post-construction, any habitat which was removed will be re-instated. Therefore the residual impact is assessed as not significant.	CEMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Water Quality	There is the potential for impacts on controlled waters to arise. For both an over ground electrical connection and an underground electrical connection water quality impacts may arise due to: surface water run-off to the local watercourses; permeation of pollutants to local aquifers; and, drainage of any under grounded parts of the electrical connection (e.g. over head cable tower / cable sealing end compound bases or underground cable trenches) to local watercourses or land for natural soak away. Furthermore, if an underground electrical connection is selected there may also be: increased sedimentation from open-cut crossings of streams and rivers (if required). Similar impacts are anticipated for the National Grid Infrastructure. For a longer electrical connection route, potential impacts may be experienced over a wider area.	This impact will be managed and controlled through a CEMP and drainage strategy. No untreated water will be allowed to drain to controlled waters. If an underground electrical connection is selected, any water crossings will be designed to reduce impacts on water bodies[4].	The residual impact is assessed as not significant.	CEMP.

[4] *Note that design procedures are outlined in Appendix C1 of this ES FID.*

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Geology and Land Contamination	For both an over ground electrical connection and an underground electrical connection contaminants (such as fuels and concrete) will be used either at the tower / cable sealing end compound sites (for the over ground cables) or along the working width (for the underground cables). In addition, there is the potential for land contamination to occur as a result of spillages. Unidentified 'hot spots' of pollution could be encountered. For a longer electrical connection route, potential impacts may be experienced over a wider area. Similar impacts are anticipated for the National Grid Infrastructure.	This impact will be managed and controlled through a CEMP. Procedures will be put in place to deal with any pollution spills. Where hot spots are encountered, these will be remediated as necessary, in the appropriate manner.	The residual impact is assessed as not significant.	CEMP.
Land Use	For both an over ground electrical connection and an underground electrical connection there may be temporary loss of productive agricultural land at either the tower / cable sealing end compound sites (for the over ground cables) or along the working width (for the underground cables). For a longer electrical connection route, potential impacts may be experienced over a wider area. Similar impacts are anticipated for the National Grid Infrastructure.	The land used temporarily for laydown / occupation will be subject to protection measures during the construction works, and re-instated after. Productive agricultural land required will be minimised during electrical connection route selection.	All land will be re-instated post construction. Therefore, the residual impact is assessed as not significant.	CEMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Traffic	For both an over ground electrical connection and an underground electrical connection there may be additional construction traffic in the form of HGVs and construction personnel vehicles who would require access to either the tower / cable sealing end compound sites (for the over ground cables) or working width (for the underground cables). For a longer electrical connection route, potential impacts may be experienced over a wider area. Similar impacts are anticipated for the National Grid Infrastructure.	Traffic will be managed and controlled through a CTMP.	Construction traffic associated with the electrical connection will be less concentrated, as it will not be necessary for all vehicles accessing the working width to do so via one site entrance. Therefore this spreads the traffic across the proposed access network and limits the impact on any one particular road. However, this may affect the smaller local roads in the area, and result in potential nuisance for nearby residents. Due to the low level of construction traffic generation and existing traffic on these roads, the residual impact is assessed as not significant.	CEMP / CTMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Cultural Heritage	The cultural heritage in the area is well understood from the work undertaken for GEC and the LG Development. In addition it should be noted that the works will predominately be taking place in an environment that is subject to regular disturbance from agricultural activities. As such, the existence and whereabouts of any existing cultural heritage features which have the potential to be impacted upon are already well understood. These will be avoided. For both an over ground electrical connection and an underground electrical connection, there is a potential for the setting of cultural heritage features (i.e. Listed Buildings) to be subject to landscape and visual impacts. In addition, if an underground electrical connection is selected, there is a greater potential for unknown cultural heritage features to be impacted upon. For a longer electrical connection route, potential impacts may be experienced over a wider area. Similar impacts are anticipated for the National Grid Infrastructure.	Depending on the understanding of the cultural heritage potential of the section of the electrical connection route, a range of mitigation measures can be implemented. These range from: • Agreeing a plan of Archaeological Works to be used during construction (to be developed and agreed with the Essex County Archaeologist); • Using a targeted Archaeological Watching Brief; • Using soil stripping as an early construction activity to allow sufficient time for any investigation and recording to take place; and • If an underground electrical connection is selected, alteration of the construction technique to allow important features to remain *in situ*, wherever possible.	Any cultural heritage / archaeological remains will be recorded and described as part of the targeted Archaeological Watching Brief. The residual impact is assessed as minor adverse / not significant depending on whether any unknown cultural heritage features are encountered. However, if an underground electrical connection is selected, it should be noted that may also be positive effects associated with the discovery of unknown cultural heritage features which increase knowledge / understanding of a particular site.	CEMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Socio-Economics	For both an over ground electrical connection and an underground electrical connection there are short term employment opportunities during the construction works. Similar impacts are anticipated for the National Grid Infrastructure.	The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	Residual positive impact, albeit short term.	None Required.
Safety	There are a number of safety considerations which need to be implemented such that the electrical connection can be designed, built and tested (i.e. constructed) in such a way that its integrity is not comprised during its operational lifetime. The National Grid Infrastructure will be subject to similar safety considerations.	The electrical connection will be designed and constructed in line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.	The residual impact is assessed as not significant.	Compliance with relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.
Health	During construction, there may be the potential for impacts on health due to air / dust emissions, noise and transport.	The aspects of the environment most likely to cause impacts on health (air / dust emissions, noise and transport) are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan (HMP).	The residual impact is assessed as not significant.	CEMP (for other aspects of the environment listed above) / HMP.

Indirect / Secondary Impacts – Operation

GEC

18.4.5 It is expected that, during operation, the main indirect / secondary impacts will be associated with air quality, noise and vibration, and landscape and visual.

18.4.6 Furthermore, it is expected that there will be negligible indirect / secondary impacts on ecology, geology, hydrogeology and land contamination, traffic, cultural heritage or socio-economics during operation of GEC.

18.4.7 Table 18.3 summarises the likely indirect / secondary impacts of GEC.

Electrical Connection

18.4.8 It is expected that, during operation, the main indirect / secondary impacts will be associated with an over ground electrical connection (including the National Grid Infrastructure) in terms of landscape and visual, and land use. There are no indirect / secondary impacts associated with the under ground electrical connection, save for those associated with the National Grid Infrastructure in terms of landscape and visual, and land use.

18.4.9 Furthermore, it is expected that there will be no indirect / secondary impacts on air quality, ground contamination, water resources, ecology, socio-economics and cultural heritage / archaeology during operation of the electrical connection.

18.4.10 Additionally, indirect / secondary impacts associated with traffic, noise, and electro-magnetic fields are not considered significant, and therefore no mitigation is proposed. This is due to the following reasons:

- *Traffic* – Traffic will be limited to infrequent maintenance checks and emergency situations. Due to the infrequent nature of this trip, this is not considered to present an impact.
- *Noise* – There is the potential for low level noise associated with an over ground electrical connection / National Grid Sub-station, especially during damp / wet weather conditions. However, this is not expected to be a significant source of noise.
- *Electro-magnetic Fields* – There is the potential for electric and magnetic fields to be associated with the transmission lines / National Grid Infrastructure. However, NGET and their predecessors have carried out extensive studies into the effects of these fields. The advice provided by NGET suggests that fields normally encountered by people living and working in their vicinity do not have an adverse health impact. Similarly it is advised that electric and magnetic fields are unlikely to have any impacts on farming or related activities.

18.4.11 Therefore, Table 18.4 summarises the likely indirect / secondary impacts of an electrical connection (including the National Grid Infrastructure). It should be noted that the indirect / secondary impacts noted cover all four potential connections which have been described previously in Section 18.2 (Electrical Connection). However, distinctions are made where the impacts of an over ground electrical connection would differ from an underground electrical connection, or the impact of a longer route would differ from a short route.

TABLE 18.3 – LIKELY IMPACTS OF THE OPERATION OF GEC

Impact Type	***Operation Impacts***	***Mitigation***	***Residual Effects***	***Means by which Mitigation will be Delivered***
Air Quality	During operation, there will be emissions of nitrogen oxides (NO_x).	GEC will be equipped with proven pollution control technology, which will limit the production of NO_x to a level below that required by the LCPD.	The residual impact is assessed as not significant.	By Design / Condition of Consent / Permit.
Noise	During operation, there may be continuous low level noise from GEC.	GEC will feature integral acoustic enclosures designed to ensure that noise levels generated are within the acceptable limits.	The residual impact is assessed as not significant.	By Design / Condition of Consent / Permit.
Landscape and Visual	It is likely that there will be landscape and visual impacts associated with GEC.	GEC will be situated on land within the LG Development. Materials and finishes will be selected to minimise maintenance requirements, and be sympathetic to the appearance of the surrounding LG Development.	Due to the likely use of the surrounding land, the likely appearance of GEC and the screening afforded by the LG Development, the residual impact is assessed as not significant.	By Design.
Safety	There are a number of safety considerations which need to be implemented such that GEC can be operated in such a way that its integrity is not comprised.	GEC will be operated in line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.	The residual impact is assessed as not significant.	Compliance with relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.
Health	During operation, there may be the potential for impacts on health due to air emissions and noise.	The aspects of the environment most likely to cause impacts on health (air emissions and noise) are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan.	The residual impact is assessed as not significant.	CEMP (for other aspects of the environment listed above) / HMP.

TABLE 18.4 – LIKELY IMPACTS OF THE ELECTRICAL CONNECTION OPERATION

Impact Type	*Operation Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Landscape and Visual	For both an over ground electrical connection and an underground electrical connection, there will likely be landscape and visual impacts. For an over ground electrical connection these will arise through the presence of the towers, cable sealing end compounds, electrical cable and National Grid Infrastructure. For a longer electrical connection route these will be experienced over a wider area. For an underground electrical connection, these will arise through the presence of the National Grid Infrastructure.	If an over ground electrical connection is selected, mitigation will include careful route selection and consideration of alternatives, taking into account the guidance in EN-5 (on routing and over ground electrical connections versus those under grounded) and the Holford Rules. The landscape and visual impact of the over ground electrical connection will influence the final decision on the route selection. For both the over ground electrical connection and underground electrical connection, the National Grid Infrastructure will be screened by planting to reduce visual impacts.	If an over ground electrical connection is selected, it is likely that there will be significant adverse landscape impacts (where the proposed over ground electrical connection route diverges from the existing transmission lines) and significant adverse visual impacts (primarily in areas where the over ground electrical connection route passes in relatively close proximity to residential receptors which have a view of the proposed route). For both the over ground electrical connection and underground electrical connection, it is likely that the landscape and visual impacts associated with the National Grid Infrastructure will reduce over time as the screening becomes more effective. Therefore the residual impact is assessed as not significant.	Careful route and National Grid Sub-station selection / consideration of alternatives. Legal agreement with the relevant landowners.

Impact Type	*Operation Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Land Use	Permanent occupation of agricultural land For an over ground electrical connection this will be through the presence of the towers, cable sealing end compound and National Grid Infrastructure. For an underground electrical connection this will be through the National Grid Sub-station.	The landowner will be compensated by financial means for the permanent occupation of land.	It is not anticipated that the transmission towers cable sealing end compounds / National Grid Infrastructure will pose any threat to the viability of any farm on which they will be located. Therefore, the residual impact is assessed as not significant.	Legal agreement with the relevant landowners.
Safety	There are a number of safety considerations which need to be implemented such that electrical connection can be operated in such a way that its integrity is not comprised. The National Grid Infrastructure will be subject to similar safety considerations.	The electrical connection will be operated in line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.	The residual impact is assessed as not significant.	Compliance with relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.
Health	During operation, there may be the potential for impacts on health.	The aspects of the environment most likely to cause impacts on health) are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan.	The residual impact is assessed as not significant.	CEMP (for other aspects of the environment listed above) / HMP.

18.5 Cumulative Impact Assessment

18.5.1 The following Section identifies the main likely cumulative impacts during the construction and operation of GEC, the electrical connection and the LG Development.

Cumulative Impacts – Construction

GEC

18.5.2 Table 18.1 summarises the cumulative impacts resulting from the construction of GEC.

18.5.3 Electrical Connection

18.5.4 Table 18.2 summarises the cumulative impacts resulting from the construction of the electrical connection.

LG Development

18.5.5 Table 18.5 summarises the likely cumulative impacts resulting from the construction of the LG Development.

Cumulative Impacts – Operation

GEC

18.5.6 Table 18.3 summarises the cumulative impacts resulting from the operation of GEC.

Electrical Connection

18.5.7 Table 18.4 summarises the cumulative impacts resulting from the operation of the electrical connection.

LG Development

18.5.8 Table 18.6 summarises the likely cumulative impacts resulting from the operation of the LG Development.

TABLE 18.5 – LIKELY IMPACTS OF THE LG DEVELOPMENT CONSTRUCTION

Impact Type	***Construction Impacts***	***Mitigation***	***Residual Effects***	***Means by which Mitigation will be Delivered***
Air Quality	During construction, there is the potential for dust emissions to arise.	Outline Planning Application (OPA) Conditions[5] 67 (wheel cleansing), 69 (management of dust) and 76 (CEMP). A Framework Construction Management Strategy (FCMS), which includes provisions for air quality mitigation during the construction period, has been submitted and approved by the Local Planning Authority in consultation with relevant stakeholders. All contractors employed at the LG Development will be required to submit detailed proposals which comply with the FCMS.	Following implementation of the mitigation, LG Development ES states that there will be no residual impact.	OPA Conditions / Construction Management Strategy.
Noise and Vibration	Noise generating plant will be used during the construction phase. LG Development ES states that there will be changes to the baseline noise levels at a number of identified receptors.	OPA Conditions 68 (control of noise) and 76 (CEMP). A Framework Construction Management Strategy (FCMS), which includes provisions for noise mitigation during the construction period, has been submitted and approved by the Local Planning Authority in consultation with relevant stakeholders. All contractors employed at the LG Development will be required to submit detailed proposals which comply with the FCMS.	Following implementation of the mitigation, LG Development ES states that the residual impact will range between none (night time) and moderate adverse (day time).	OPA Conditions / Construction Management Strategy.

[5] *The OPA Conditions for the LG Logistics and Business Park are attached in Appendix H.1 . It should be noted that similar provisions exist in the HEO Conditions for the LG Port, and therefore the OPA Conditions are considered to reflect the general required conditions over the LG Development.*

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Landscape and Visual	Landscape and visual impacts associated with the construction of the LG Development.	Aside from the measures discussed in the LG Development ES, DP World – London Gateway are not required to provide any construction mitigation.	The LG Development ES states that the residual impacts will vary depending on development and receptor. The findings are summarised here: <u>LG Logistics and Business Park</u> • Landscape Impacts – Negligible / None to Moderate Adverse • Visual Impacts – Negligible / None to Moderate Adverse <u>Road</u> • Landscape Impacts – Negligible / None to Major Adverse • Visual Impacts – Negligible / None to Major Adverse <u>Rail</u> • Landscape Impacts – Negligible / None to Major Adverse • Visual Impacts – Negligible / None to Moderate Adverse	Mitigation only as described in LG Development ES[6].

[6] *'OPA Environmental Statement' (Complied Version 2004)*

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Ecology	Despite the nature of the site, and the program of clearance and remediation being undertaken, there is potential for impacts on ecological receptors.	OPA Conditions 73 (Ecological Management and Mitigation Plans), 74 (Ecological Action Plans), 75 (Ecological Advisory Group) and 76 (CEMP). Habitat surveys (and, if required, protected species surveys) are being undertaken prior to construction works commencing on site. Measures to introduce biodiversity enhancements on and off site are being identified. Ecology clearance and relocation of species are being undertaken under licenses pursuant to the Conservation (Natural Habitats and c. Regulations 1994 (as amended). The Ecological Management and Mitigation Plans for the LG Port and Logistics and Business Park detail the proposed mitigation as a result of the LG Port HEO.	Following implementation of the mitigation, LG Development ES[7] states that the residual impact will vary for individual ecological receptors, including: • Plants – Negligible • Badger – Negligible • Bats – Minor Adverse • Brown Hare – Minor Adverse • Water Vole – Negligible to Moderate Adverse • Birds – Minor Adverse • Invertebrates – Negligible • Reptiles / Amphibians – Minor Adverse	OPA Conditions

[7] *'OPA Environmental Statement' (Complied Version 2004)*

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Water Quality	There is the potential for impacts on controlled waters to arise.	OPA Conditions 29 (temporary drainage scheme), 30 (monitoring of outfalls) and 76 (CEMP). A Framework Construction Management Strategy (FCMS), which includes provisions for drainage and water quality mitigation during the construction period, has been submitted and approved by the Local Planning Authority in consultation with relevant stakeholders. All contractors employed at the LG Development will be required to submit detailed proposals which comply with the FCMS.	Following implementation of the mitigation, LG Development ES[8] states that the residual impacts may be minor adverse.	OPA Conditions / Construction Management Strategy.

[8] *'OPA Environmental Statement' (Complied Version 2004)*

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Geology and Land Contamination	Due to the location of the LG Development site, and the historical land uses, there is a high potential for contamination to be present on site. Contaminants (such as fuels and concrete) will be used on site. There is the potential for land contamination to occur as a result of spillages.	OPA Conditions 83 (earthworks), 84 (testing of imported materials), 89 (ground condition assessment and remediation scheme), 90 (stripping and storage of topsoil) and 76 (CEMP). A Framework Construction Management Strategy (FCMS), which includes provisions for ground contamination mitigation during the construction period, has been submitted and approved by the Local Planning Authority in consultation with relevant stakeholders. All contractors employed at the LG Development will be required to submit detailed proposals which comply with the FCMS.	Following implementation of the mitigation, LG Development ES[9] states that the residual impacts will be: • None – on solid and drift geology; • Minor Beneficial due to the reduction in residual contamination and reduction in potential for unexploded ordnance; and • Minor Adverse due to generation of wastes that cannot be treated for use on site.	OPA Conditions / Construction Management Strategy.

[9] *'OPA Environmental Statement' (Complied Version 2004)*

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Traffic	There may be additional construction traffic in the form of HGVs and construction personnel vehicles.	OPA Conditions 63 (parking management scheme), 61 (notification of preferred routes), 62 (preferred routes) and 76 (CEMP). A Framework Construction Management Strategy (FCMS), which includes provisions construction traffic mitigation, has been submitted and approved by the Local Planning Authority in consultation with relevant stakeholders. All contractors employed at the LG Development will be required to submit detailed proposals which comply with the FCMS.	Due to the low levels of construction traffic expected, the residual impact is assessed as not significant.	OPA Conditions / Construction Management Strategy.
Cultural Heritage	Due to the nature of the site, and its historical uses, there is potential for impacts on cultural heritage and archaeology.	OPA Conditions 91 (programme of archaeological work), 92 (archaeological method statement) and 76 (CEMP).	Following implementation of the mitigation, LG Development ES states that the residual impact will vary between none and minor adverse.	OPA Conditions
Socio-Economics	Short term employment opportunities during the construction works.	The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	Residual positive impact, albeit short term.	None Required.

TABLE 18.6 – LIKELY IMPACTS OF THE LG DEVELOPMENT OPERATION

Impact Type	***Operation Impacts***	***Mitigation***	***Residual Effects***	***Means by which Mitigation will be Delivered***
Air Quality	LG Development ES states there may be local air quality effects and greenhouse gas effects associated with the operation of the LG Development.	OPA Conditions 57. 58 and 59.	Following implementation of the mitigation, LG Development ES states: • No residual impacts to local air quality • Moderate adverse impacts due to greenhouse gas effects	OPA Conditions.
Noise and Vibration	LG Development ES states there may be traffic and industrial noise associated with the operation of the LG Development which will increase the baseline noise levels.	OPA Conditions 51, 54, 55, 70 and 71 all deal with requirements for acoustic barriers. OPA Condition 56 requires low noise surfacing on The Manorway (A1014). OPA Condition 72 restricts the placing of plant machinery on walls or roofs of buildings without prior approval.	Following implementation of the mitigation, LG Development ES states the post mitigation residual impacts are an increase in the baseline noise levels. A summary of the residual impacts with and without the development of the proposed rail improvements associated with the LG Logistics and Business Park are: • Impacts due to daytime operational traffic – not significant • Impacts due to daytime industrial activities – not significant • Impacts due to night time operational traffic – minimal adverse • Impacts due to night time industrial activities – minor adverse	OPA Conditions.

Impact Type	*Operation Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Landscape and Visual	Landscape and visual impacts associated with the operational LG Development.	The LG Development has been designed to minimize any landscape and visual impacts. OPA Conditions 77 (strategic landscaping), 78 (landscape scheme), 79 (landscape management plan), 80 (hard and soft landscape works), 81 (hard and soft landscape works), 82 (dead or damaged trees) and 83 (earthworks). OPA Condition 72 restricts the placing of plant machinery on walls or roofs of buildings without prior approval.	Following implementation of the mitigation, LG Development ES states that the residual impacts will vary depending on development and receptor. The findings are summarised here: <u>LG Logistics and Business Park</u> • Landscape Impacts – Moderate Benefit to Minor Adverse • Visual Impacts – Minor Benefit to Moderate Adverse <u>Road</u> • Landscape Impacts – Minor Benefit to Minor Adverse • Visual Impacts – Minor Benefit to Minor Adverse <u>Rail</u> • Landscape Impacts – Negligible / None to Minor Adverse • Visual Impacts – Negligible / None to Minor Adverse	OPA Conditions.

Impact Type	*Operation Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Ecology	Despite the nature of the site, and the program of clearance and remediation being undertaken, there is potential for impacts on ecological receptors.	OPA Conditions 73 (Ecological Management and Mitigation Plans), 74 (Ecological Action Plans), and 75 (Ecological Advisory Group). The Ecological Management and Mitigation Plans for the LG Port and Logistics and Business Park detail the proposed mitigation as a result of the LG Port HEO.	Following implementation of the mitigation, LG Development ES states that the residual impact will vary for individual ecological receptors, including: • Plants – Negligible • Badger – Negligible to Minor Adverse • Bats – Minor Adverse • Water Vole – Minor Adverse • Birds – Minor Adverse • Invertebrates – None • Reptiles / Amphibians – Negligible to Minor Beneficial	OPA Conditions
Traffic	There may be large traffic volumes and movement associated with the operation of the LG Development. The potential for cumulative impacts of this operational traffic with GEC will be determined by the timing of the uptake of sites within the LG Development. Construction traffic associated with the GEC will be small in comparison to the total anticipated trip generation of the LG Development. However, it is feasible that the construction of GEC could be completed prior to the generation of any significant LG Development operational traffic.	OPA Conditions and Obligations include: highway improvement schemes; Travel Plans; Travel Plan Committee; and, Section 106 contributions towards highway mitigation.	There will be no significant cumulative impact on the local road network as a result of GEC and the LG Development.	OPA Conditions and Obligations.

Assessment of Cumulative Impacts

Type 1 Cumulative Impacts

18.5.9 The cumulative effects of different types of impact or impact interactions from the proposed developments on particular receptors have been considered both during the construction stage and the operation stage.

Type 1 Cumulative Impacts – Construction

18.5.10 It is considered that the greatest likelihood of impact interaction, and hence significant impacts, would occur during the construction phase. Indeed, construction impacts are generally more adverse (albeit on a temporary basis) than operational impacts.

18.5.11 Details of the construction phases of the developments are given in Table 18.7.

TABLE 18.7 – DETAILS OF CONSTRUCTION FOR THE VARIOUS DEVELOPMENTS

	Gas Connections	***GEC***	***Electrical Connection***	***LG Development***
Construction Activities	• Route preparation and installation of temporary access routes and crossings (if required) • Top-soil stripping • Trench excavation • Pipe laying • Backfilling • Pressure testing • Installation of off take AGI • Restoration	• Site preparation and enabling works • Installation of plant, associated sub-buildings and the sub-station • Commissioning	• Route preparation and installation of temporary access routes and crossings (if required) • Relocation of existing facilities (if required) • Construction of tower foundations • Erection of towers • Conductor stringing • Restoration	• Site preparation and enabling works • Construction of the LG Development and associated infrastructure
Construction Area / Corridor	Approximately 23 ha	11.3 ha (includes 4.7 ha of land reserved for CCR / CCS)	Approximately up to 36 ha	607 ha (approximately)
Programme Dates	Between 2013 and 2014	2012 to 2015	Between 2013 and 2015	2010 – Construction ongoing.
Duration	9 to 12 months	28 to 36 months	18 months	Ongoing

18.5.12 Rather than undertaking an assessment of the potential for significant impacts on each possible receptor, groups of sensitive receptors have been chosen which are likely to be the most sensitive to Type 1 Cumulative Impacts. The criteria for identifying those receptors which are considered likely to be sensitive has included existing land uses, proximity to construction works and likely duration of exposure to impacts.

18.5.13 For the purposes of the assessment, and in order to ensure that likely significant effects are assessed, a worst case scenario has been assumed, namely that receptors will be subject to construction impacts throughout the duration of the construction works. However, it is likely that construction of the gas pipeline (and also the electrical connection) would be in stages, and the construction activities would travel along the line of the route as sections are completed.

18.5.14 Table 18.8 presents the likely Type 1 Cumulative Impacts that may be felt during construction of the developments. However, there is the potential for some construction to occur at a later date. If this is the case the environmental impacts may continue for a longer time, but the cumulative impacts may be reduced.

TABLE 18.8 – LIKELY TYPE 1 CUMULATIVE IMPACT INTERACTIONS DURING CONSTRUCTION OF THE DEVELOPMENTS

Sensitive Receptor	***2012***	***2013***	***2014***	***2015***
Nearby residential properties	D / N / V / T	D / N / V / T	D / N / V / T	Very minor impacts
Adjacent commercial users	D / N / T	D / N / T	D / N / T	Very minor impacts
Land owners	D / N / L / T	D / N / L / T	D / N / L / T	No impacts
Protected species	D / N	D / N	D / N	No impacts
Surface water / agricultural drainage systems	D / N / T	D / N / T	D / N / T	No impacts
Agricultural land	D / N	D / N	D / N	No impacts

D – Temporary, local, adverse dust impacts
N – Temporary, local, adverse noise impacts
V – Temporary, local, adverse visual impacts
L – Temporary loss of land
T – Temporary, local, adverse traffic impacts

18.5.15 As shown in Table 18.8, the majority of the impacts arise from activities such as: dust from plant and vehicles; noise and vibration for construction plant and vehicles; landscape and visual impact of the works; and passing HGVs.

18.5.16 However, as described in Section 18, a CEMP will be implemented during the construction phase of the gas pipeline and associated AGI, likely secured by an appropriate planning condition. As it is assumed that similar CEMPs will be in place for the other developments, a mechanism will be in place to minimise construction impacts 'at source' in order to reduce the likely impacts on surrounding receptors.

18.5.17 As a result, overall it is considered that any impact interactions occurring will generally be temporary and short term in nature. Furthermore these can be mitigated to a large extent by the control measures set out the appropriate CEMPs.

18.5.18 Therefore the likely Type 1 Cumulative Impacts predicted to occur during construction are likely to be not significant.

Type 1 Cumulative Impacts – Operation

18.5.19 Similar to the approach used above, rather than undertaking an assessment of the potential for significant impacts on each possible receptor, groups of receptors have been chosen which are considered likely to be the most sensitive to Type 1 Cumulative Impacts. In addition, for the purposes of the assessment a worst case scenario has been assumed, namely that receptors will be subject to all operational impacts.

18.5.20 Table 18.9 presents the likely Type 1 Cumulative Impacts that may be felt during the operation of the developments.

TABLE 18.9 – LIKELY TYPE 1 CUMULATIVE IMPACT INTERACTIONS DURING OPERATION OF THE DEVELOPMENTS

Sensitive Receptor	***Operational Lifetime of Developments***
Nearby residential properties	V / T
Adjacent commercial users	T
Land owners	L
V – Visual impacts L – Permanent loss of land T – Traffic impacts	

18.5.21 The mitigation measures, as have been described previously, will reduce the likely Type 1 Cumulative Impacts during operation. Therefore the likely Type 1 Cumulative Impacts predicted to occur during operation are largely assessed to be not significant.

Type 2 Cumulative Impacts

18.5.22 An initial screening exercise was undertaken to identify which aspects of the environment may be subject to Type 2 Cumulative Impacts as a result of the construction and operation of the developments.

Type 2 Cumulative Impacts – Construction

18.5.23 Table 18.10 summarises the likely Type 2 Cumulative Impacts which could be encountered during construction. In addition, Table 18.10 summarises the proposed mitigation and determines the significance of the likely Type 2 Cumulative Impacts.

Type 2 Cumulative Impacts – Operation

18.5.24 Table 18.11 summarises the likely Type 2 Cumulative Impacts which could be encountered during operation. In addition, Table 18.11 summarises the proposed mitigation and determines the significance of the likely Type 2 Cumulative Impacts.

TABLE 18.10 – LIKELY TYPE 2 CUMULATIVE IMPACTS DURING CONSTRUCTION OF THE DEVELOPMENTS[10]

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[11]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Air Quality	During construction, there is the potential for dust emissions to arise. Dust impacts will be managed and controlled through a CEMP.	During construction, there is the potential for dust emissions to arise. Dust impacts will be managed and controlled through a CEMP.	During construction, there is the potential for dust emissions to arise. Dust impacts will be managed and controlled through a CEMP.	During construction, there is the potential for dust emissions to arise. Mitigation included in OPA Conditions and Construction Management Strategy (see Table 18.5 for details)	Cumulative impacts are likely to be insignificant. Mitigation as described.
Noise	Noise generating plant will be used during the construction phase. Construction plant and activities will be managed and controlled through a CEMP.	Noise generating plant will be used during the construction phase. Construction plant and activities will be managed and controlled through a CEMP.	Noise generating plant will be used during the construction phase. Construction plant and activities will be managed and controlled through a CEMP.	Noise generating plant will be used during the construction phase / changes in baseline noise levels at a number of sensitive receptors. Mitigation included in OPA Conditions and Construction Management Strategy (see Table 18.5 for details)	Cumulative impacts are likely to be insignificant. Mitigation as described.

[10] *Reference should be made back to Tables 18.1, 18.2 and 18.5*
[11] *Including National Grid Infrastructure*

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[11]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Landscape and Visual	Landscape impacts may arise on Local Landscape Character due to construction. Visual impacts will arise from the presence of cranes, machinery, excavations and temporary structures, etc. Construction works will be screened by hoarding, where practical, to mitigate landscape and visual impacts near to sensitive receptors.	It is unlikely that there will be any impacts on the landscape character. It is likely that visual impacts will occur. Construction works will be screened by hoarding, where practical, to mitigate and landscape and visual impacts near to sensitive receptors.	Landscape impacts may arise on Local Landscape Character due to construction. Visual impacts will arise from the presence of cranes, machinery, excavations and temporary structures, etc. Construction works will be screened by hoarding, where practical, to mitigate landscape and visual impacts near to sensitive receptors.	Landscape impacts vary from Negligible / None to Major Adverse. Visual impacts vary from Negligible / None to Major Adverse. Aside from the measures discussed in the LG Development ES, DP World – London Gateway are not required to provide construction mitigation.	Likely temporary significant adverse cumulative impacts during construction. Mitigation as described. These impacts will be temporary in nature, and as such the residual impact is assessed as not significant.
Ecology	There is the potential for impacts on ecology to arise during the construction phase. Habitat surveys and protected species surveys will be undertaken prior to construction works commencing on site. Areas where protected species are known to occur or areas with the potential to support ecological habitat will be avoided where possible, and removal of habitat will not occur during the breeding season.	Due to the nature of the site, and the program of clearance and remediation being undertaken, there is limited potential for impacts on ecological receptors. Habitat surveys (and, if required, protected species surveys) will be undertaken prior to construction works commencing on site. Measures to introduce biodiversity enhancements on and off site will be indentified.	There is the potential for impacts on ecology to arise during the construction phase. Habitat surveys and protected species surveys will be undertaken prior to construction works commencing on site. Areas where protected species are known to occur or areas with the potential to support ecological habitat will be avoided where possible, and removal of habitat will not occur during the breeding season.	Despite the nature of the site, and the program of clearance and remediation being undertaken, there is potential for impacts on ecological receptors. Mitigation included in OPA Conditions (see Table 18.5 for details).	Cumulative impacts are likely to be insignificant. Mitigation as described.

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[11]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Water Quality	There is the potential for impacts on controlled waters to arise. This impact will be managed and controlled through a CEMP and drainage strategy. No untreated water will be allowed to drain to controlled waters. Any water crossings will be designed to reduce impacts on water bodies.	There is the potential for impacts on controlled waters to arise. This impact will be managed and controlled through a CEMP and drainage strategy.	There is the potential for impacts on controlled waters to arise. This impact will be managed and controlled through a CEMP and drainage strategy. No untreated water will be allowed to drain to controlled waters. Any water crossings will be designed to reduce impacts on water bodies.	There is the potential for impacts on controlled waters to arise. Mitigation included in OPA Conditions and Construction Management Strategy (see Table 18.5 for details).	No cumulative impacts identified.

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[11]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Geology, Hydrogeology and Land Contamination	Contaminants (such as fuels and concrete) will be used on site. There is the potential for land contamination to occur as a result of spillages. This impact will be managed and controlled through a CEMP. Procedures will be put in place to deal with any pollution spills / hotspots encountered.	Due to the location of the site, and the historical land uses, there is a high potential for contamination to be present on site. Contaminants (such as fuels and concrete) will be used on site. There is the potential for land contamination to occur as a result of spillages. A full program of remediation will be undertaken prior to the commencement of construction. A risk assessment will be carried out prior to the commencement of construction work on site. This impact will be managed and controlled through a CEMP. Procedures will be put in place to deal with any pollution spills.	Contaminants (such as fuels and concrete) will be used on site. There is the potential for land contamination to occur as a result of spillages. This impact will be managed and controlled through a CEMP. Procedures will be put in place to deal with any pollution spills / hotspots encountered.	Due to the location of the LG Development site, and the historical land uses, there is a high potential for contamination to be present on site. Contaminants (such as fuels and concrete) will be used on site. There is the potential for land contamination to occur as a result of spillages. Mitigation included in OPA Conditions and Construction Management Strategy (see Table 18.5 for details).	No cumulative impacts identified.

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[11]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Land Use	Temporary loss of productive agricultural land. The land used temporarily for laydown / occupation will be subject to protection measures during the construction works, and re-instated after. Productive agricultural land required will be minimised during pipeline route selection.	No impacts anticipated.	Temporary loss of productive agricultural land. The land used temporarily for laydown / occupation will be subject to protection measures during the construction works, and re-instated after. Productive agricultural land required will be minimised during electrical connection route selection.	No impacts anticipated.	No cumulative impacts identified.
Traffic	There may be additional construction traffic in the form of HGVs and construction personnel vehicles. Traffic will be managed and controlled through a CTMP.	There may be additional construction traffic in the form of HGVs and construction personnel vehicles. Traffic will be managed and controlled through a CTMP.	There may be additional construction traffic in the form of HGVs and construction personnel vehicles. Traffic will be managed and controlled through a CTMP.	There may be additional construction traffic in the form of HGVs and construction personnel vehicles. Mitigation included in OPA Conditions (see Table 18.5 for details).	Cumulative impacts are likely to be insignificant. Mitigation as described.

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[11]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Cultural Heritage	The cultural heritage in the area is well understood from the work undertaken for GEC and the LG Development / undertaking of agricultural activities. There is a potential for the setting of cultural heritage features (i.e. Listed Buildings) to be subject to landscape and visual impacts. There is also a potential for unknown cultural heritage features to be impacted upon. Depending on the understanding of the cultural heritage potential, a range of mitigation measures can be implemented. These range from using a targeted Archaeological Watching Brief to alteration of the construction technique. The residual impact is assessed as minor adverse / not significant depending on whether any unknown cultural heritage features are encountered.	The cultural heritage in the area is well understood from the work undertaken for GEC and the LG Development. As such, the existence and whereabouts of any existing cultural heritage features which have the potential to be impacted upon are already well understood. It is unlikely that there will be any archaeological remains of significance. An assessment of the likelihood of archaeological remains of significance on the proposed site will be undertaken and prior to construction, a plan of archaeological works will be developed in conjunction with the Essex County Archaeologist. If it is discovered that archaeological remains are present, an archaeological watching brief will be used during construction.	The cultural heritage in the area is well understood from the work undertaken for GEC and the LG Development / undertaking of agricultural activities. There is a potential for the setting of cultural heritage features (i.e. Listed Buildings) to be subject to landscape and visual impacts. If an underground electrical connection is selected, there is a potential for unknown cultural heritage features to be impacted upon. Depending on the understanding of the cultural heritage potential, a range of mitigation measures can be implemented. These range from using a targeted Archaeological Watching Brief to alteration of the construction technique. The residual impact is assessed as minor adverse / not significant depending on whether any unknown cultural heritage features are encountered.	Due to the nature of the site, and its historical uses, there is potential for impacts on cultural heritage and archaeology. Mitigation included in OPA Conditions and Construction Management Strategy (see Table 18.5 for details).	No cumulative impacts identified.

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[11]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Socio-Economics	Short term employment opportunities during the construction works. The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	Short term employment opportunities during the construction works. The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	Short term employment opportunities during the construction works. The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	Short term employment opportunities during the construction works. The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	Positive cumulative impacts identified. No mitigation required.
Safety	The gas connection will be designed and constructed n line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation. The residual impact is assessed as not significant.	GEC will be designed and constructed n line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation. The residual impact is assessed as not significant.	The electrical connection will be designed and constructed n line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation. The residual impact is assessed as not significant.	N / A	No cumulative impacts identified.
Health	The aspects of the environment most likely to cause impacts on health are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan (HMP). The residual impact is assessed as not significant.	The aspects of the environment most likely to cause impacts on health are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan (HMP). The residual impact is assessed as not significant.	The aspects of the environment most likely to cause impacts on health are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan (HMP). The residual impact is assessed as not significant.	N / A	No cumulative impacts identified.

TABLE 18.11 – LIKELY TYPE 2 CUMULATIVE IMPACTS DURING OPERATION OF THE DEVELOPMENTS[12]

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[13]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Air Quality	No impacts identified.	Emissions of nitrogen oxides (NO_x). Impacts will not be significant.	No impacts identified.	There may be local air quality effects and greenhouse gas effects associated with the operation of the LG Development. Mitigation included in OPA Conditions (see Table 18.6 for details).	Cumulative impacts are likely to be insignificant. Mitigation as described.
Noise	There is the potential for low level noise associated with the off take Above Ground Installation (AGI). High specification, low noise plant will be specified during the design phase. Regular maintenance checks will be carried out to ensure plant is working efficiently. Broken or faulty plant will be repaired or replaced.	During quiet periods, the operation of GEC may generate low level noise. Impacts will not be significant.	No impacts identified.	There may be traffic and industrial noise associated with the operation of the LG Development which will increase the baseline noise levels. Mitigation included in OPA Conditions (see Table 18.6 for details).	Cumulative impacts are likely to be insignificant. Mitigation as described.

[12] *Reference should be made back to Tables 18.3, 18.4 and 18.6*
[13] *Including National Grid Infrastructure*

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[13]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Landscape and Visual	It is likely that there will be landscape and visual impacts associated with the off take AGI. The landscape and visual impact of the off take AGI will be screened by planting to reduce visual impacts.	Limited Local Landscape Character Impact. It is likely that visual impacts will occur.	There will likely be landscape and visual impacts associated with the operation of an over ground electrical connection solution / National Grid Sub-station. The landscape and visual impact of an over ground electrical connection will influence the final decision on the route selection. The National Grid Sub-station will be screened by planting to reduce visual impacts.	Landscape impacts vary from Moderate Benefit to Minor Adverse. Visual impacts vary from Minor Benefit to Moderate Adverse. The LG Development has been designed to minimize any landscape and visual impacts. Mitigation included in OPA Conditions (see Table 18.6 for details).	Likely significant adverse cumulative impacts during operation. Mitigation as described.
Ecology	No impacts identified.	Limited potential for ecological impacts.	No impacts identified.	Despite the nature of the site, and the program of clearance and remediation being undertaken, there is potential for impacts on ecological receptors. Mitigation included in OPA Conditions (see Table 18.6 for details).	Cumulative impacts are likely to be insignificant. Mitigation as described.
Water Quality	No impacts identified.	Increase in water consumption.	No impacts identified.	No impacts identified.	No cumulative impacts identified.
Geology, Hydrogeology and Land Contamination	No impacts identified.	Post-mitigation, there are no potential risks associated with the GEC site	No impacts identified.	The geology, hydrogeology and land contamination impacts are deemed to be positive due to the regeneration of a contaminated site.	No cumulative impacts identified.

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[13]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Land Use	Permanent occupation of agricultural land by off take AGI. Productive agricultural land required will be minimised.	No impacts identified.	Permanent occupation of agricultural land by transmission towers / National Grid Sub-station. Productive agricultural land required will be minimised.	No impacts identified.	Cumulative impacts are likely to be insignificant. Mitigation as described.
Traffic	No material impacts identified.	No material impacts identified.	No material impacts identified.	Large traffic volumes and movement associated with the operation of the Port and Business and Logistics Park. Mitigation included in OPA Conditions and Obligations (see Table 18.6 for details).	Following mitigation, cumulative impacts are likely to be insignificant.
Cultural Heritage	No impacts identified.	It is unlikely that there will be any archaeological remains of significance.	No impacts identified.	No impacts identified.	No cumulative impacts identified.
Socio-Economics	No impacts identified.	Employment opportunities during the operation of GEC. The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	No impacts identified.	The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	Positive cumulative impacts identified. No mitigation required.

Impact	*Gas Connection*	*GEC*	*Electrical Connection*[13]	*LG Development*	*Likely Cumulative Impacts and Mitigation*
Safety	The gas connection will be operated in line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation. The residual impact is assessed as not significant.	GEC will be operated in line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation. The residual impact is assessed as not significant.	The electrical connection will be operated in line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation. The residual impact is assessed as not significant.	N / A	No cumulative impacts identified.
Health	The aspects of the environment most likely to cause impacts on health are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan. The residual impact is assessed as not significant.	The aspects of the environment most likely to cause impacts on health are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan. The residual impact is assessed as not significant.	The aspects of the environment most likely to cause impacts on health are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan. The residual impact is assessed as not significant.	N / A	No cumulative impacts identified.

18.6 Discussion of CCR / CCS Impacts

Carbon Capture Readiness / Carbon Capture and Storage

18.6.1 GEC will be designed so as to be CCR, with space made available in the design to allow for the retrofitting of a carbon capture plant in the future. This is discussed further in the CCR Feasibility Study which has been submitted in February 2010 in support of the Section 36 Consent application for GEC.

18.6.2 In accordance with the DECC November 2009 CCR Guidance (Paragraph 48) it should be noted that:

"*At the CCR stage, given the inevitable uncertainty about the precise route* [for the CO_2 pipeline] *and what might by the CCS stage in the future be the safety and environmental requirements, we do not envisage any formal environmental impact assessment being undertaken. This will however need to be done when an operator wishes to fit CCS to the plant*".

Therefore:

"*In order to retrofit CCS, Government has made it clear that a further Section 36 Consent application will be required, in addition to the consents and licences necessary for CO_2 transport and storage. At this point an EIA covering the impacts arising from CCS at the power station will be conducted*".

18.6.3 Nevertheless, in addition to the high level assessment included in the CCR Feasibility Study, the likely significant environmental effects associated with the implementation of CCS at GEC are assessed. However, due to the likely delay in the implementation of CCS there is a greater level of uncertainty associated with the development details. Therefore, the following assessment is based on an understanding of the likely construction processes and assumptions on timing, duration and knowledge of baseline conditions.

CCR / CCS Impacts – Construction

18.6.4 Table 18.12 summarises the likely impacts resulting from the construction of a CCS solution at GEC.

CCR / CCS Impacts – Operation

18.6.5 Table 18.13 summarises the likely impacts resulting from the operation of a CCS solution at GEC.

TABLE 18.12 – LIKELY INDIRECT / SECONDARY IMPACTS OF GEC RESULTING FROM CCS SOLUTION CONSTRUCTION

Impact Type	***Construction Impacts***	***Mitigation***	***Residual Effects***	***Means by which Mitigation will be Delivered***
Air Quality	During construction, there is the potential for dust emissions to arise.	Dust emissions will be managed and controlled through a CEMP.	The residual impact is assessed as not significant.	CEMP.
Noise	Noise generating plant will be used during the construction phase.	Construction plant and activities will be managed and controlled through a CEMP.	Although all construction works will be undertaken in accordance with a CEMP, it is still likely that there may be minor, temporary local noise impacts at receptors located between 100 m and 300 m from the construction site. The residual impact is assessed as not significant.	CEMP.
Landscape and Visual	Landscape Impacts may arise on Local Landscape Character due to construction. Visual Impacts will arise from the presence of cranes, machinery, excavations and temporary structures, etc.	Construction works will be screened by hoarding, where practical, to mitigate landscape and visual impacts near to sensitive receptors.	Although mitigation measures will reduce landscape and visual impacts, and the magnitude of change would be minimized due to the context of the development, it is likely that significant adverse landscape and visual impacts will arise during the construction phase. These impacts will be temporary in nature, and as such the residual impact is assessed as not significant.	CEMP.
Ecology	Due to the nature of the site, and the program of clearance and remediation being undertaken, there is limited potential for impacts on ecological receptors.	Habitat surveys (and, if required, protected species surveys) will be undertaken prior to construction works commencing on site. Measures to introduce biodiversity enhancements on and off site will be identified.	The residual impact is assessed as not significant.	CEMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Water Quality	There is the potential for impacts on controlled waters to arise.	This impact will be managed and controlled through a CEMP and drainage strategy. No untreated water will be allowed to drain to controlled waters.	The residual impact is assessed as not significant.	CEMP.
Geology and Land Contamination	Due to the location of the site, and the historical land uses, there is a high potential for contamination to be present on site. Contaminants (such as fuels and concrete) will be used on site. There is the potential for land contamination to occur as a result of spillages.	A full program of remediation will be undertaken prior to the commencement of construction. A risk assessment will be carried out prior to the commencement of construction work on site. This impact will be managed and controlled through a CEMP. Procedures will be put in place to deal with any pollution spills.	The risk assessment will identify the risks on site, and the likelihood of significant impacts / significant harm. If necessary, further remediation and mitigation measures will be undertaken to reduce the likelihood of significant impacts / significant harm. Post-mitigation, the residual impact is assessed as not significant.	CEMP.
Traffic	There may be additional construction traffic in the form of HGVs and construction personnel vehicles.	Traffic will be managed and controlled through a CTMP. It is proposed that the construction of the CCS Solution will be similar in scale to the construction of GEC. Therefore the assessment of traffic impacts is expected to be similar.	The residual impact is assessed as not significant.	CEMP / CTMP.
Cultural Heritage	No impacts are anticipated.	As assessment of the likelihood of archaeological remains of significance on the proposed site will be undertaken. If it is discovered that archaeological remains are present, an archaeological watching brief will be used during construction.	Any archaeological remains will be recorded and described as part of the archaeological watching brief. The residual impact is assessed as not significant.	CEMP.

Impact Type	*Construction Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Socio-Economics	Short term employment opportunities during the construction works.	The socio-economic impacts are deemed to be positive, therefore no mitigation is required.	Residual positive impact, albeit short term. The residual impact is assessed as not significant.	None Required.
Safety	There are a number of safety considerations which need to be implemented such that the CCS Solution can be designed, built and tested (i.e. constructed) in such a way that its integrity is not comprised during its operational lifetime.	The CCS Solution will be designed and constructed in line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.	The residual impact is assessed as not significant.	Compliance with relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.
Health	During construction, there may be the potential for impacts on health due to air / dust emissions, noise and transport.	The aspects of the environment most likely to cause impacts on health (air / dust emissions, noise and transport) are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan (HMP).	The residual impact is assessed as not significant.	CEMP (for other aspects of the environment listed above) / HMP.

TABLE 18.13 – LIKELY INDIRECT / SECONDARY IMPACTS OF GEC RESULTING FROM CCS SOLUTION OPERATION

Impact Type	*Operation Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Air Quality	During operation, there is the potential for atmospheric emissions of chemicals / substances used in the CCS Solution.	Any potential emissions arising from the CCS Solution will be fully investigated during the development / design stages (and incorporated into any EIA / ES produced). Any emissions will be at a level lower than those required by EU or UK Law.	It is unlikely that there will be any significant residual impacts.	Condition of Consent / Operational Permit.
Noise	Continuous noise from the operation of the CCS Solution.	The CCS Solution will generate noise which will be a similar type and character to GEC. As with GEC, appropriate noise emissions limits will be set for any noise emitting elements to ensure that the standard and criteria for the GEC site are achieved for both the individual and cumulative development.	It is unlikely that there will be any significant residual impacts.	Condition of Consent / Operational Permit.
Landscape and Visual	Limited landscape impacts. Visual impacts associated with the proposed CCS Solution.	The CCS Solution will be designed to minimize any landscape and visual impacts. Planting will be instated to screen low level impacts.	It is likely that there will be significant adverse visual impacts, primarily on close proximity residual receptors where they have views towards the CCS Solution. The views will be mainly of the tall elements of the development due to local screening.	Condition of Consent.
Traffic	Negligible traffic movements.	No mitigation proposed.	The residual impact is assessed as not significant.	Condition of Consent.

Impact Type	*Operation Impacts*	*Mitigation*	*Residual Effects*	*Means by which Mitigation will be Delivered*
Safety	There are a number of safety considerations which need to be implemented such that the CCS Solution can be operated in such a way that its integrity is not comprised.	The CCS Solution will be operated in line with the latest editions of the relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.	The residual impact is assessed as not significant.	Compliance with relevant Codes of Practice, Standards, Recommendations and Statutory Legislation.
Health	During operation, there may be the potential for impacts on health due to air emissions, noise and transport.	The aspects of the environment most likely to cause impacts on health (air emissions, noise and transport) are all subject to mitigation measures. Therefore no specific additional mitigation is required. However, applicable mitigation measures may be drawn together in a Health Management Plan.	The residual impact is assessed as not significant.	CEMP (for other aspects of the environment listed above) / HMP.